RAILROAD GAZETTE

FRIDAY, DECEMBER 7, 1877.

SALISBURY IRON.

IV.

TESTS BY TORSION.

Torsion specimens, fig. 26, of standard size, viz., one inch long by 0.625 inch in diameter, were prepared from the pieces, as indicated in figs. 16 and 17, after the transverse tests were made. The torsion specimens were tested in the Autographic Recording Testing Machine of Professor Thurston, as designed and built by the class of 1876 of the Stevens Institute of Technology.

Fig. 27 is a prospective view of this machine; fig. 28 is a front elevation; fig. 29, a longitudional section on line *A A* of fig. 28; fig. 30 a transverse section on *a a'* of fig. 29, and fig. 31 is a plan with the top cross-bolt *a* removed. It consists of two A-shaped frames, *A A* and *A' A'*, shown in all the figures. These are firmly mounted on a heavy bed-plate which is shown only in fig. 27. The frames are secured to each other by cross-bolts, *a* and *a'*. Near the top of each of these frames are spindles, *C* and *D*, figs. 28, 29 and 31, each of which has a head, *E* and *H*, with a slot or jaw to receive and hold the square heads of the specimens. The two spindles are not connected to each other in any way excepting by the specimen which is placed in the jaws to be tested, as shown at *c* in figs. 29 and 30. To the spindle *D* a long arm, *H B*, is attached, which carries a heavy weight, *B*, at the lower end. The spindle *C* has a worm-gear wheel, *M M'*, attached to its outer end. This wheel is driven by a worm, *J*, on the shaft *L L'*, which is turned by a hand crank, *K*. When a specimen, *c*, is placed in the two jaws, *E*, *H*, as shown in fig. 29, and the spindle *C* is turned by the worm gear, the effect is to twist the specimen *c* which would turn the spindle *D*, but in order to do this the weight *B*, figs 29 and 30, on the end of the arm *N* must be swung in the direction in which the specimen is twisted. Now the farther the arm *N* is moved from a perpendicular position the greater will be the resistance of the weight *B* to the turning of the shaft, and as the movement of the arm and weight is effected by the force exerted through the specimen *c*, so that the position of the arm and weight will at all times be a measure of the torsional stress which is exerted on the specimen by the spindle *C* and transmitted by the former to the spindle *D*.

But as this torsional strain which is exerted on the specimen is increased it will, to use a common expression, "give way," or be twisted more or less by the strain according to the quality of the material. In making such torsional tests it is essential that we should know how much the specimen was twisted, as the strains to which it was subjected were increased. If we could procure a record of this it would be an indication of the capacity of the material to resist such strains, or, in other words, of its quality. The testing machine which we have partly described was designed by Professor Thurston for this purpose. The record is made in the following way: To the spindle *C* a cylindrical drum *G G'*, figs. 28, 29 and 31, is attached, which is covered with a suitable sheet of paper. Fig. 31 is a plan of the top of the machine, which shows the drum *G G'*. To the arm *N* a pencil holder, *d e f*, figs. 29 and 30, is pivoted at *f f*, and carries a pencil, *d*, the point of which bears on the paper on the drum *G G'*. Now supposing that the specimen in the machine should offer no resistance but should merely twist, the pencil would then remain stationary, and as the drum is revolved the pencil would trace a straight line on the paper, the length of which line would measure the amount which the specimen was twisted. If on the other hand a specimen be supposed to resist and to twist simultaneously, as is always the case, then it can readily be seen that the spindle *D* would be turned, and the arm *N* with its weight would be moved from a perpendicular position a distance proportional to the strain resisted by the specimen. The pencil-holder, being attached to the arm *N*, would move with it. As explained before, the distance which the arm *N* and its weight are moved from a perpendicular position indicates the strain on the specimen. Now, in order to make a record of this distance, a "guide curve," *F F'*, shown most clearly in fig. 31, is attached to the frame of the machine, so that when the arm *N* and the pencil-holder are moved out of their perpendicular position, shown in figs. 28 and 30, the pencil is moved towards the left by the guide curve, which is of such a form that the lateral movement which it gives to the pencil is proportional to the force exerted by the weight *B* on the end of the arm *N*. Now, suppose, if such a thing were possible, that a specimen were tested which would not "give" or twist at all: in that case the spindles *C* and *D* and the drum *G G'* and the pencil would turn together, or their movement would be simultaneous, so that the pencil would draw a straight line across the paper. But there is no material known which would not give or bend more or less, so that the pencil will always draw some form of curved line, somewhat like that shown by *G d*, fig. 31, which indicates the quality of the material tested.

Before describing the nature of these curves it should be explained that the test pieces are held in a central position in the jaws by lathe "centres," which are placed in suitable holes drilled in the spindles for that purpose. The centre in the head *H* is fixed, whereas the one in *E* is movable and has a spiral spring behind it which presses it outward, and thus holds the specimen up to the centre in the head *H*. The specimen is then held securely by wedges, which are shown by black shading in figs. 29 and 30 above and below the specimen *c*.

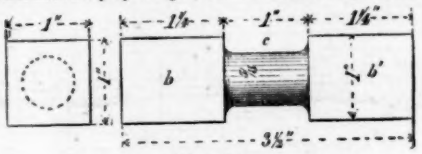

Fig. 26.

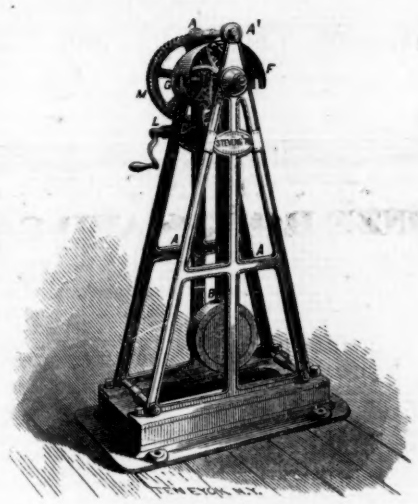

Fig. 27.

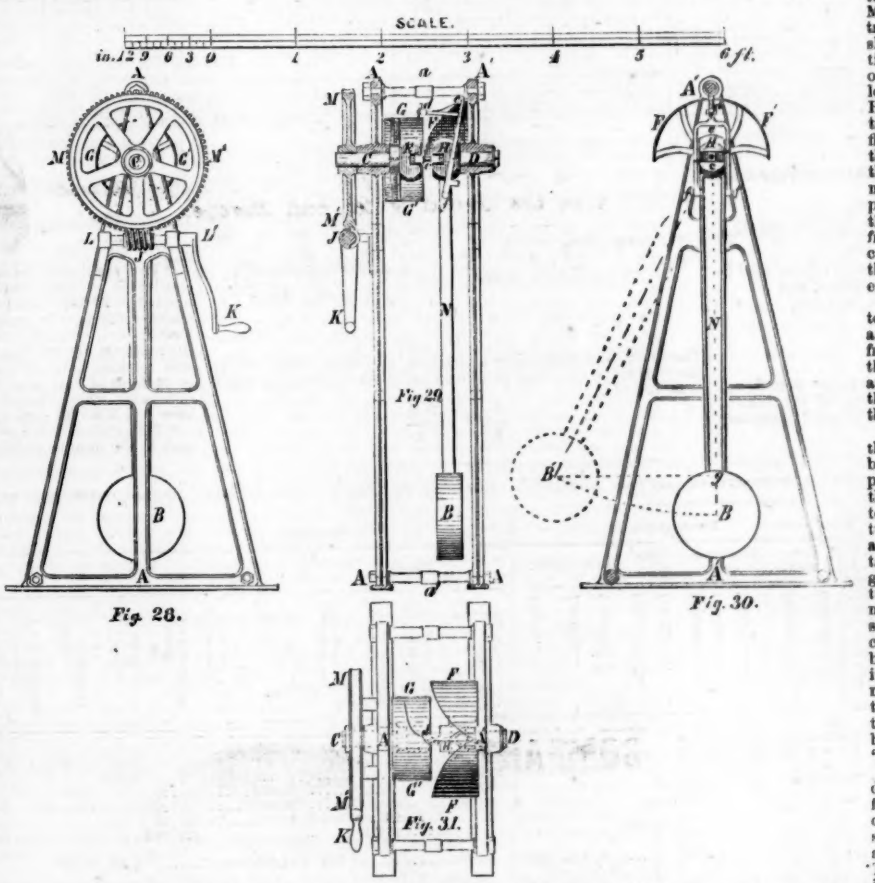

Fig. 28.

Fig. 31.

Fig. 32 represents a strain sheet with the diagrams produced by several different materials. It is engraved one half the scale of the original sheet. This blank sheet was rolled around the drum *G G'*. Now, as has been explained before, if the spindle *C* was turned and the test piece should twist without moving the spindle *D*, or weight *B*, then the pencil would draw a horizontal line on the paper, but if the test piece should not twist at all but should cause the spindle *D* to move simultaneously with *C*, then the pencil would draw a vertical straight line; so that the vertical movement of the pencil represents the stress on the specimen, and the horizontal movement its twist or "give." The vertical scale of the engraving is [(¼ in. × 100 ft.-lbs.) + 2.024.] The latter quantity is added for the friction of the machine. The horizontal scale is ½ in. = 10 degrees of twist.

The lower curve on the diagram is of copper, the next one above of wrought iron, the top one of steel, and that on the right hand of cast iron.

When the test piece is first placed in the machine and before the spindles are moved, the pencil is at 0, or at the lower right-hand corner of the diagram sheet. When the spindle *C* is turned it will be seen that the curve which represents the strain is at first nearly vertical. This indicates that the specimen or test piece has yielded very little to the strains to which it is at first subjected. The copper being a soft material, has little stiffness, and from the curve it will be seen that it very soon begins to yield, but being very ductile it continues to twist, as shown by the long curve, which is nearly horizontal. Some specimens have twisted through 475 degrees before breaking. The wrought iron curve, it will be seen, is nearly vertical up to about 90 ft.-lbs., showing much greater stiffness than copper. At 90 ft.-lbs. it begins to yield, and the sudden change in the form of the curve at *a* has been interpreted to indicate the limit of elasticity. After passing this point the specimen twisted very rapidly, but with an increasing resistance up to 168½ degrees, when it broke with a strain of 220 ft.-lbs. The steel specimen yielded only one degree under a strain of 130 ft.-lbs. It then commenced to "give," but after yielding 3¼ degrees its resistance continued to increase and it twisted through 146 degrees and broke at a strain of 4 0 ft.-lbs. Cast iron, it will be seen, has greater stiffness than either wrought iron or steel, although up to strains of 150 ft.-lbs. the steel yielded less than the cast iron. The latter, however, twisted through only 7 degrees, when it broke at a strain of 220 ft.-lbs.

Of course the curves of the materials whose diagrams are represented differ much in form according to the quality of the material. Thus the wrought iron from which the curve in the diagram was drawn was a soft, ductile metal of excellent quality. A different kind of metal might show much greater stiffness but would not twist nearly so much. The form and proportions of the diagrams thus indicated the qualities of the material. Their interpretation is explained in the report in which the operation of the machine is explained by Prof. Thurston as follows:

"In operating the machine the diagram sheet is placed in the drum *G*, and a pencil inserted in the holder; the specimen is then placed in the machine and accurately centred by being mounted on lathe centres, protruding from the back of each jaw, one centre being fixed while the other is backed by a helical spring.

"The stress is then applied by turning the handle *K*, and is transmitted through the specimen under test to the spindle from which the weighted arm, *B*, is suspended, so that, as the stress is increased the pendulum swings out of its original vertical position, assuming another which is dependent upon the magnitude of the stress transmitted. Meanwhile the strain-diagram is being traced by the pencil on the diagram sheet enveloping the drum. The friction of the journal in which the spindle of the pendulum rotates increases the load by a slight but measurable amount. Having determined this amount of friction of the journal experimentally, and finding the distance from the vertical that the centre of the weight has moved, the force transmitted through the specimen is rapidly ascertained, since the product of the reaction at the centre of the weight, in pounds, into its distance from the vertical passing through the centre of the test piece, in feet, gives the number of foot-pounds of moment exerted.*

"The guide curve *G*, above referred to, is a 'curve of sines' whose ordinates are the sines of the arc at the points from which they are erected, measuring the arc from the origin of the curve, and it is consequently cut in such shape that its ordinates are proportioned to the longitudinal to the weight.

"The yielding of the specimen, during the application of the stress, is indicated by a corresponding movement of the pencil on the paper in the direction of the abscissa; thus, were the specimens to offer no resistance, but merely to twist, the pencil would remain stationary, pencilling a straight line on the rotating drum, showing the number of degrees through which the test piece had twisted. If, on the other hand, a specimen be supposed to resist and to twist simultaneously, as is always the case, it can readily be seen that the pencil would be moved along the guide curve, recording the resistance in foot-pounds of moment, and, at the same time, the drum turns, recording the number of degrees through which the specimen is twisted by the applied stress, thus giving a "strain-diagram."

"Each inch of ordinate of the strain-diagram indicates a certain number of foot-pounds of moment, which, in the case of the machine used in testing the specimens, is 100†, and each inch of abscissa measures ten degrees of torsion. The corresponding amount of extension is obtained from the printed table.

"Therefore, having determined by actual measurement the lengths of ordinate at the elastic limit, and at the point of maximum elevation for each diagram, the values thus obtained are substituted in the following formula:

$$\left[\frac{a}{(\text{Inches of ordinate} \times 100)} + \frac{b}{2{,}024}\right] \text{foot-pounds},$$

the amount *a* being the stress, measured in foot-pounds, arising from the resistance of the pendulum of the testing-machine, supposing no friction, and *b* being a constant resistance to which the specimen is subjected in consequence of the friction of the journal, aforementioned.

"The resulting values in foot-pounds, after substitution, give, therefore, respectively, the torsional elastic limit and the ultimate torsional strength of the specimens, the column headed '*M*' of the numerical record-sheets containing the

* The term "foot-pound" used in this report, it should be remembered, is the unit of *moment*, and represents the product of the unit of weight, one pound, into the unit of leverage, or of length of lever-arm, one foot.

† The engraving is made one-half the scale of the original diagram, so that ½ in. measured vertically = 100 foot-pounds, and measured horizontally it measures 10 degrees.

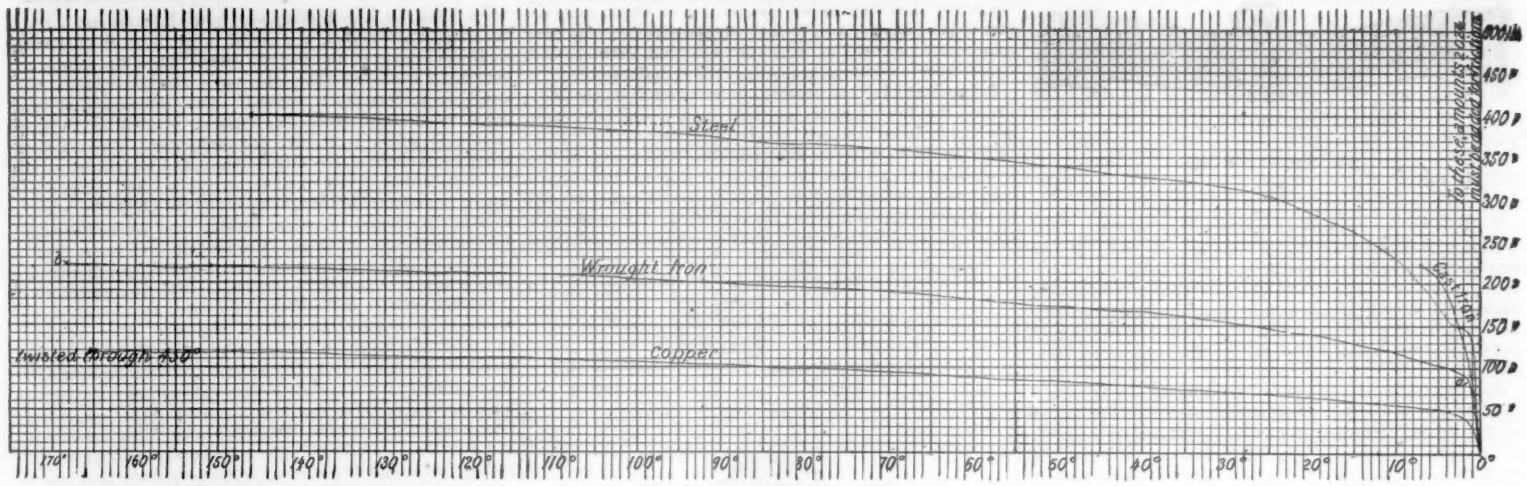

Fig. 32.

ormer values, and that headed '*M*' containing those of ultimate strength.

"The elasticity of a material is measured by the distance it will recoil when relieved of a given stress. The recoil is given in degrees, by the abscissa of an 'elasticity line' formed by gradually relieving the specimen from the applied stress; such elasticity lines were generally taken immediately after passing the elastic limit.

"The unit used to measure elasticity is the number of degrees of recoil per foot-pound of stress, *i. e.*, the quotient of the value in foot-pounds of any ordinate of the elasticity line divided *into* the number of degrees of recoil measuring from the foot of the ordinate to the elasticity line. The elasticity is therefore:

$$\frac{\text{Number of degrees of recoil}}{\text{Number of foot-pounds.}}$$

"In the record sheet the column headed "Elasticity" gives the values of these constants for the several specimens.

RESILIENCE.

The ultimate resilience of a specimen, or the mechanical work expended in rupturing the material, which is a measure of its ultimate capacity to resist shock, is the equivalent in foot-pounds of the total area of the diagram. The resiliences are given in the column headed "Resilience W." of the record sheet and are obtained as follows:

Let Q = the required resilence in foot-pounds,
A = area in square inches included in the diagram up to the point of rupture,
L = the l ngth of the base-line, in inches.
M = the number of foot-pounds of moment represented by each inch of ordinate, supposing no friction, and
R=Radius of the paper-drum, in inches, we have,

$\frac{A}{L}$ = mean ordinates of diagram,

$\frac{A}{L}M$ = value of mean ordinates in foot-pounds, or pounds applied at distance of one foot from the axis of the jaws of the machine, which is the mean force exerted to rupture the specimen;

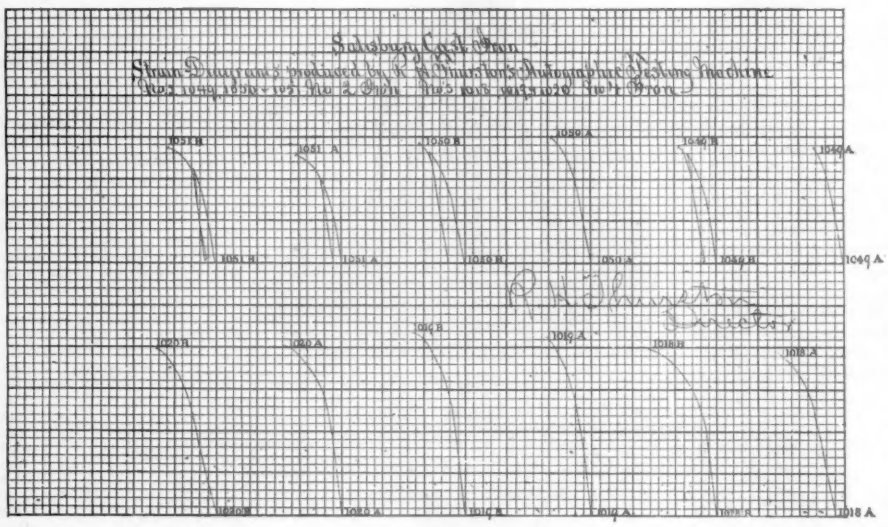

Fig. 33.

$\frac{L}{12}$ = distance moved through, in feet, by pencil; and since the pencil-point is at a distance equal to the radius of the drum from the axis, the distance through which the main force is moved is

$$\left\{\frac{R}{12}\text{=radius of drum, in feet}\right\} : \text{foot} :: \frac{L}{12}\left\{\begin{matrix}\text{distance through}\\ \text{which mean}\\ \text{force is moved}\end{matrix}\right\}$$

$$= \frac{L}{R}$$

Therefore, still supposing no friction, the work done will be the product of the mean force into the distance through which it is moved.

$$\frac{A}{L} M \times \frac{L}{R} = \frac{A\,M}{R}$$

"The friction, F, of the journal, previously referred to, assists this mean force, and is taken as acting at a distance of one foot from the axis; it therefore acts through the same distance $\frac{L}{R}$ and another quantity of work, is therefore expended equal to

$$\frac{F\,L}{R}$$

so that the total work performed is

$$Q = \frac{A\,M}{R} \times \frac{F\,L}{R}$$

"For the machine used in the testing of Nos. 1018, 1020 and Nos. 1449, 1051 the value of R was 5.72 and F, 2,024, the formula used in determining the figures for resilience given in the record sheet become

$$Q = (A \times 17.482) + (L \times 0.354)$$

"The values for the elastic resilience, or the work expended in straining the material to its elastic limit, are determined in the same manner as those for the ultimate resilience. To find the resilience for the el stic limit, the area a, of the initial portion of the diagram up to the limit of elasticity is measured, as also the abscissa l, corresponding to that point, which when substituted in the formula above given, M F and R remainingthe same, we have the following:

$$\text{Resilience within the elastic limit} = q = a\frac{N}{R} + l\frac{F}{R}, \text{ or } q = (a \times 17.482) + (l \times 0.354)$$

"The resilience calculated within the elastic limit for the specimens of cast iron tested are recorded in the column, headed "Elastic Resilience; W'," of the record sheet. The elastic resilience is probably the most generally valuable determination, since this measures the work necessary to strain the material beyond what in practice is usually considered the safe working point of the material. The ultimate resilience is perhaps of less practical value, as it is a measure of the resistance which would be offered to the effects of a single blow which would destroy the material.

"The relative ductility of the specimens is shown by a reference to the figures in the columns 'θ_E,' 'θ_R' and 'Extension;

TABLE OF THE MECHANICAL PROPERTIES OF CAST IRON, MECHANICAL LABORATORY, DEPARTMENT OF ENGINEERING, STEVENS INSTITUTE OF TECHNOLOGY.

Name.	Authority.	Specific gravity.	Fusion.	Dimensions. Tension. Length.	Tension. Diameter.	Compression. Length.	Compression. Diameter.	Torsion. Length.	Torsion. Diameter.	Transverse. Length.	Transverse. Breadth.	Transverse. Depth.
				in.	in.	in.	in.	in.	in.	in.	in.	in.
A.—Salisbury Iron, No. 2		7.186	1	5	0.798	2	0.5	1	.625	22	1	1
B.— " " No. 4		7 259	1	6	0.798	2	0.5	1	.625	22	1	1
C.— No. 1	Wade.	7.086	2	23	2.2	1.507	.605	...	...	20	2.09	2.081
D.	Rodman.	.....	2	35	1.382	10	1.382	...	...	...	...	...
	Rodman.	.....	2	35	1.382	10	1.382	...	...	...	...	...
E.	Mechanical	.....	..	6	0.798	.....	.....	1	.625	36	1	1
	Laboratory.	.....	..	...	.....	...	...	1	.625	...	...	...
ENGLISH.				lt.	area.					ft.		
F.—Bieneavon Cast Iron, No.2	Hodgkinson	7.113	..	50	1.0685	1.5	.752	...	...	9	1 96	2.01
G.—Low Moor " " No.1	Hodgkinson.	7.074	..	ft.	area					ft.		
		7.043	..	50	1.058	1.5	.752	...	...	9	1.98	2.01

Name.	Strength. Elastic. Tension. Pounds per sq. in.	Compression. Pounds per sq. in.	Torsion. Foot-pounds.	Transverse. Pounds.	Strength. Ultimate. Tension. Pounds per sq. in.	Compression. Pounds per sq. in.	Torsion. Foot-pounds.	Transverse. Pounds.
A.—Salisbury Iron, No. 2	7,333	47 535	305.92	320	20,500	87,429	579.28	1,383
B.— " " No. 4	12,0 0	56,022	461.98	600	34,407	127 323	839.93	2,060
C.— No. 1	21,344	.....	.....	.....	.....	104.357	.....	9,600
D.	6,000	.....	.....	.....	26,000	.....	.....	.....
	4,500	.....	.....	.....	21,000	.....	.....	.....
E.	.....	.....	235.52	305.5	18,800	.....	465.92	690
	.....	.....	173.13	.....	.....	.....	554.38	.....
F.—Bieneavon Cast Iron, No.2	6,289	.....	.....	560	14,675	100,967	.....	1,207
G.—Low Moor " " No.1	6,352	.....	.....	448	16,408	79,318	.....	1,207

Name.	Resilience. Elastic. Tension. Foot-pounds.	Compression. Foot-pounds.	Torsion. Foot-pounds.	Transverse. Foot-pounds.	Resilience. Ultimate. Tension. Foot-pounds.	Compression. Foot-pounds.	Torsion. Foot- ounds.	Transverse. Foot-pounds.
A.—Salisbury Iron, No. 2	0.572	7.90	1.29	1.0527	17.34	66.075	8.59	35.99
B.— " " No. 4	0.965	1 79	8.39	2.763	20.28	31..58	17.88	49.15
C.— No. 1	.....	.....	.....	.....	.....	.....	.....	.....
D.	9.4	.....	.....	.....	3?6	.....	.....	.....
	13.4	.....	.....	.....	309.2	.....	.....	.....
E.	.....	.....	1.84	17.76	.....	.....	33.20	90.9
	.....	.....	0.747	.....	.....	.....	11.22	.....
F.—Bieneavon Cast Iron, No.2	79.56	.....	.....	22.75	1425 7	.....	.....	190.62
G.—Low Moor " " No.1	82.44	.....	...	15 86	1094.6	.....	.....	169.34

Name.	Ductility. Elastic. Tension. Percentage of length.	Compression. Percentage of length.	Torsion. Degrees twisted.	Transverse. $\frac{L}{\delta}$	Ductility. Ultimate. Tension. Percentage of length.	Compression. Percentage of length.	Torsion. Degrees twisted.	Transverse. $\frac{L}{\triangle}$
A.—Salisbury Iron, No. 2	0.0736	1.015	1.3°	0.0357	0.5473	8.62	4.83	0.0243
B.— " " No. 4	0.0641	0.187	1.7	0.00503	0.3725	9.72	6.89	0.0228
C.— No. 1	.....	.....	.....	.....	.....	12.4	.....	.....
D.	0 027	.....	.....	.....	0 322	.....	.....	.....
	0.0264	.....	.....	.....	0.336	.....	.....	.....
E.	0.0292	.....	4	0.0096	.....	.....	12.5	0.0293
	.....	.....	1.4	0	.....	.....	8.25	.....
ENGLISH.								
F.—Bieneavon Cast Iron, No. 2	0 0519	.....	.....	0.009	0.1395	.....	.....	0.0263
G.—Low Moor " " No. 1	0.0511	.....	.....	0.00787	0.1524	.....	.....	0.0311

Name.	Stiffness. Tension. Modulus of elasticity. E.	Transverse. Modulus of elasticity. E.	Torsion. $\frac{M'}{\theta_E}$	Compression at 8,000 lbs. per sq. in.	Ratio of set to Ultimate Distortion. Tension. Per c nt.	Compression. Per cent.	Transverse. Per cent.
A.—Salisbury Iron, No. 2	11,450,754	10,733,121	57.58	0.0117s	23.46	59.07	22.40
B.— " " No. 4	15,968,254	14,333,302	74.04	0.000982	20.17	....	20.15
C.— No. 1	.....	.....	.....	.....	.....	93.5	6.66
D.	2 ,231,422	.....	.....	.....	41.70	.....	.....
	17,064,846	.....	.....	.....	55 17	.....	.....
E.	.....	12,395,100	14.4	.....	.....	.....	29.28
	.....	.....	30.19	.....	.....	.....	.....
F.—Bieneavon Cast Iron, No. 2	12,492,200	13.380,800	...	.....	13.85	.....	1.758
G.—Low Moor " " No. 1	12,631,000	8,961,300	.....	.....	1?.96	.....	2.070

Proof Ultimate,' in the record sheets; the former representing respectively the abscissas in inches at the elastic limit and at the end of the diagram, multiplied by 10 (horizontal scale: 10 degrees = 1 inch). The figures recorded in the columns headed 'Extension; Proof, Ultimate,' are taken from the 'Table of Extensions' forwarded herewith and represent respectively the amount of elongation in parts of its length of an external fibre when the specimen has been twisted up to the 'elastic limit' and to the 'point of rupture.'

MODULI OF TORSION.

"Under this head in the record-sheet will be found figures representing values of three constants found in the formulas ordinarily given for torsional stress and angles of torsion.

"That designated as 'A^E' is the value of

$$\frac{\pi\, c}{310 \times 32}$$

in the formula for determining the angle of torsion in degrees,

$$\theta = \frac{32\, M\, L}{\pi\, c\, h^4}$$ (Rankine's Machinery and Mill Work, page 503),

in which

θ = the angle measured on the arc,

and

h = the diameter of the specimen.

"Substituting the value of θ in degrees

$$\left\{\theta^E = \frac{360}{\pi\, h}\ \theta\right\}$$

and transposing we have

$$\frac{360 \times 32\, M\, L}{\pi^2\, c\, h^5}$$

"By transposing and substituting the value of A^E we have

$$A^E = \frac{M\, L}{\theta^E\, h^5}$$

"The quantities designated as 'A^1' and 'A' are the values of $\frac{\pi}{16}$ q in the formula,

$$M = \frac{\pi}{16}\, q\, h^3$$ (Rankine's Machinery and Mill Work, p. 501),

A^1 being the value at the elastic limit and A at the rupture.*

DISCUSSION.

"Comparing the two grades of cast iron tested two facts are at once noticeable, (1) the great superiority of one in strength; (2) the great superiority of the other in ductility under any given load. No. 2 iron has 50 per cent. of the ultimate breaking strength of No. 4, but it proves to be about twice as ductile.

"The plotted strain diagrams in Art. III. show distinctly the differences between the two metals. Thus, under 1,200 pounds transverse stress, No. 2 deflected 0.4175 inch and No. 4, 0.2330 inch; the ratio is not preserved throughout the curve but varies somewhat, becoming greater with higher stresses and less as the initial portion of the curve is approached.

"The total resilience of No. 4 iron is greater than that of No. 2; but the resilience under equal loads is much greater with No. 2 than with No. 4. From the curve of sets, it is seen that cast iron takes a set under the slightest load and that No. 2 takes a far greater set under a given load than does No. 4. This property is decidedly more marked in the tests by transverse and tensile stresses than in those by compressive stress.

"It can readily be seen from inspection of the curves and of the table of 'Mechanical Properties of Cast Iron' sent herewith, that No. 4 iron is decidedly the *stiffer* of the two. Within the elastic limit, we find No. 4 vastly superior to the No. 2 in all its mechanical properties, since No. 4 has a much higher elastic limit and its ductility is slightly the greater.

"The difference in elastic resilience seems to be more marked than in any other property, the ratio being approximately,

in torsion	6.5 to 1
in tension	2.75 to 1
in transverse	2 to 1
and in compression	1.12 to 1.

"Comparing these tests with the records of tests on irons of other manufacturers it is seen by examination of this table that No. 2 is far superior in tenacity to English iron of the same grade in the several mechanical properties. In transverse strength the ratio is 1.3 to 1 in favor of Salisbury; at the elastic limit they are about equal. The English iron is most ductile.

"Tests of American iron are so few and so unsatisfactory as to render comparisons difficult. I have computed the records of a few from the Report on Experiments made by Capt. Rodman U. S. A. and by Major Wade, and from our records, all of which will serve to give some indication of the relative standing of Salisbury cast iron

"In tenacity, both in ultimate and elastic resistances, I have been able to find no records of iron of the same grade and fusion equal to them. The experiments made by Capt. Rodman gave greater ultimate strength, the specimens having been cut from a gun (second fusion) from near the surface. It is not stated how the gun was cast, nor the quality of metal used.

"In all other mechanical properties, as exhibited in tests by tension, Salisbury cast iron is found far ahead of all others to date, not excepting those tested by Capt. Rodman.

"Under transverse stress, No. 2 is slightly below, except in ultimate strength, and No. 4 is superior except in ductility, to the only American cast iron tested by transverse stress of which we have found records; its grade is unknown and the comparison is therefore of little value.

"In torsion, the elastic and ultimate strength of No. 2 cast iron are higher than those of any other iron of which we have records.

"In all valuable qualities the Salisbury irons, as is shown by the appended tables and diagrams, are exceptionally excellent. In combined strength, elasticity, ductility, resilience, and in homogeneousness, both in structure and as to strain, and in uniformity of quality in the several samples, they are proven to be very superior metals."

Very respectfully,

R. H. THURSTON, Director.

*Fac similies of the set of strain diagrams are shown on a reduced scale in fig. 33. The upper set are those of the No. 2 and the lower set of the No. 4 iron. The characteristic differences are plainly seen.

THE SCRAP HEAP.

Hot Blast for Locomotives.

Mr. B. T. Babbitt, of New York, recently purchased a locomotive, which he is now fitting up at Whitesboro, N. Y., to test some improvements designed by him, which are thus described by the Utica *Herald:* "Beginning at the front, the smoke bonnet has been lengthened sufficient to permit the introduction of a large coil of pipe, through which the feed-water from the tender is forced, and as the pipe is exposed to the hot products of combustion as they come through the boiler tubes, it is expected the feed-water will be heated nearly to the boiling point before it enters the boiler, thus effecting a large saving in fuel. Perhaps the most noticeable change will be found in the smoke stack. This, instead of being the usual kind, consists of a cylinder of boiler iron about four feet in diameter and about six feet high. This is filled with a multitude of small tubes (similar to an upright tubular boiler), through which the smoke and heat pass up and off At the top of this cylinder, on front and rear, are large openings fitted with valves that are operated from the cab. From the bottom of the stack a large iron pipe extends down around the boiler and connects with the front of the ash-pan. The action is to be as follows: The cold, outside air will be admitted to the interior of the smoke-stack through the upper openings, and coming in contact with the small tubes, which are highly heated by the hot gases passing up through them, will in turn have its temperature raised to a high degree and will pass down through the lower pipe and be discharged into the ash-pan beneath the fire, thus creating a hot blast, which is of admitted economy. The same principle applied at the establishment of Mr. Babbitt in New York has effected a saving of 35 per cent. in fuel. The ash-pan differs from the usual style in being arranged so that all openings can be tightly closed to exclude cold air, and are controlled from the cab. There is also a small pipe leading from the ash-pan to a point above the fire in the fire-box, enabling sufficient hot air to be introduced over the fire to insure free combustion of the gases liberated by heat. With a few minor exceptions, the engine otherwise does not differ from the usual style."

Limitations of Amendments to Charters.

In the State of New Jersey *ex rel.* the Morris & Essex Railroad Company against Yard, Commissioner of Railroad Taxation, on appeal from the Court of Errors and Appeals of New Jersey, the United States Supreme Court holds as follows:

A statute of a State which delares that any charter of a corporation granted after its passage may be altered, amended or repealed by the Legislature does not necessarily apply to supplements to a charter already passed, though the supplement be subsequent to the statute, nor does a provision in a supplement to the charter which says that this supplement (and the charter to which it is a supplement may be altered or amended by the Legislature) apply to a contract with the company made in a supplement passed long after. Such reservations to the right to repeal found in statutes, unlike similar provision in the constitution of a State, are only binding on succeeding Legislatures so far as they choose to adopt them, and a legislative contract may be made which is not repealable if the Legislature so intend. It is, therefore, in any case, a question whether the Legislature making a contract intended that the former provision for repeal or amendment should become a part of the new contract by implication. In this case it is said the contract of 1865 for a specific rate of taxation is inconsistent with any such implication. There was a subject of dispute and a fair adjustment of the controversy for a valuable consideration on both sides. The contract assumed by the requirements of the Legislature spoke of a formal written contract signed by both parties, and the terms of contract that this tax shall be in lieu and satisfaction of all other taxation or imposition whatever by or under the authority of the State—when viewed in the light of the whole transaction, do not admit an idea of the right of the State to revoke it at pleasure. Reversed. Justice Miller delivered the opinion. Justice Bradley took no part in the decision.

Tramps.

The Elmira (N. Y.) *Advertiser* of Nov. 30 says: "Monday night the Lehigh Valley express train, that arrives in Elmira about a quarter after six, ten minutes, or thereabouts, ahead of Erie No. 1 from the east, experienced quite an incident. At Waverly half a dozen tramps boarded the train, taking passage between the express cars, on the bumpers. Near Wellsburg, six miles from Elmira, the engineer heard the bell ring, the usual signal to stop. He whistled and the train was stopped pretty lively, the conductor and every one else, including the engineer, wondering what the commotion was. Between Waverly and Elmira the Lehigh train runs pretty middling fast, as it is necessary to keep out of the way of the Erie Express close following. As soon as the Valley train stopped, the tramps jumped off and made for a piece of woods hard by. Of course the mystery was explained as soon as they were discovered, and you may be sure there were some very angry train-men about that time. Conductor Billy Cummings shot at them a few times with his revolver, but he didn't see any one drop. There can be no other explanation of the affair than that they probably intended, if opportunity offered, to 'go through the express car;' but the opportunity not presenting itself they preferred stopping the train and getting off to coming to Elmira to break stone. The danger they placed the train in was very great. She lost quite a little time by this performance. A flagman, or lamp-man, as it was dark, was sent back to signal the Erie express, one of the two fastest on the road. The Lehigh picked itself up and slid along, while the flagman stopped No. 1 and got aboard, coming with it to Elmira. Perhaps the transaction may not be set down as a narrow escape, but if No. 1 had happened to crash into the rear of the Lehigh we would rather have been somewhere else at the time than right there."

Train Accident Report—A Correction.

Our report of train accidents for October contained the following: "On the 28th, two cars of a construction train on the St. Louis & Southeastern road ran off the track near Tradewater, Ky., killing one man and injuring three others badly."

The report was taken from a Tennessee paper. We are now informed that there is no such station as Tradewater on the St. Louis & Southeastern road, and that no such accident as that described took place on that road. We desire to make our train accident report as nearly correct as possible, but mistakes will sometimes occur, as in this case, as it is impossible for us to verify, in all cases, the accounts received. Tradewater is a station on the Paducah & Elizabethtown road.

An American Palace Car in Norway.

In a description of the opening of the extension of the Norwegian State Railroad to Trondhjem, the *Aftenbladet*, published at Christiana, Norway, thus speaks of the palace car recently sent out by the Jackson & Sharp Co., of Wilmington, Del.:

"The royal car moved throughout the entire trip with wonderful steadiness and uniformity, in fact to such an extent that His Majesty King Oscar was able for quite a period to carry on his regular correspondence without being disturbed by any jolting or unpleasant motion of the car. In order that the public might examine the royal car, it was put upon a siding after the completion of the trip, so that ladies and gentlemen desiring to do so might have a good view of it inside and outside. It was, in fact, full of curious visitors all day and was much admired. The royal car, as is well known, is the first railroad car in this country of the American pattern. It possesses great practical advantages, both as regards comfort and convenience of passengers and the train hands."

The Railroads and the Post-Office Department.

The following is from the annual report of the Postmaster-General, submitted to Congress with the President's message:

The railroads of the country constitute the main lines, the arteries, so to speak, of our postal system, and it is of the highest importance that our railway mail service be as perfect in its organization and as reliable in its operation as possible. The relations between the railroad officers and the Department have been and are now of a most friendly character. The managers of the railroads all over the country manifest a disposition to aid the Government in the prompt, safe, speedy and regular transmission of the mails, and very few controversies have arisen between the officers of the Department and those of the railroads in regard to the postal service. Indeed, during the late unfortunate labor-strikes, and the disorders following them, the railroad companies therein involved made every reasonable effort to carry the mails during the disorderly period, and resumed the service promptly when the turbulence subsided; and those roads not disturbed immediately notified the Department that they were ready to assist it by forwarding the delayed mails over their lines.

It is hoped that these friendly relations will be continued, but it may be well to provide remedies against their disturbance. Should a dispute arise between any railroad company and the Government in regard to carrying the mail, the company has it in its power to oppose or resist the demands of the Government by refusing longer to carry the mails, leaving this Department to make such other arrangements for their transportation as may be within its ability. It is easy to see that serious interruptions of the postal service and consequent embarrassments to the business of the country may result from such a condition of affairs.

To prevent or provide against such evil consequences, I suggest that legislation would be advisable to compel the railroads to carry the mails on terms to be prescribed by law. It might be well to leave the matter of compensation to the discretion of the Postmaster-General within such narrowly circumscribed boundaries as may be prescribed by Congress. If this officer and the railroad companies should, for any cause, fail to agree as to the terms of the service, or the compensation therefor, let there be a commission, board of arbitration, or other tribunal established by law to which such disputes may be referred upon the application of the Postmaster-General or of the railroad authorities.

Specifications for Boiler Material.

The following are the specifications made by the Chicago, Burlington & Quincy Company, and insisted upon by its inspector:

STEEL SHEETS.

Grain.—To be uniform throughout, and of a fine, close texture.

Workmanship.—Sheets to be of uniform thickness, a smooth finish, free from surface blisters, and sheared closely to size ordered.

Tensile Strength.—To be not less than 65,000 lbs. per square inch for fire-box and 60,000 lbs. for shell sheets.

Working Test.—A piece from each sheet to be heated to a dark cherry red, plunged in water at a temperature of 60° Fahr. and bent double, cold, under the hammer; another similar piece heated to a cherry red and bent double under the hammer; such pieces to show no flaw after doubling.

IRON SHEETS.

Grain.—To be uniform throughout, showing a homogeneous metal without layer or seam.

Workmanship.—Same as steel sheets.

Tensile Strength.—To be 60,000 lbs. for fire-box and 55,000 for shell sheets.

Working Test.—A piece from each sheet to be bent to a right angle *cold*, and a similar piece bent double *hot*, to show no fracture or flaking.

Lines on an Old Railway Engine.

The following lines, by Joseph P. Anthony, of Manchester appeared in the *Dublin University Magazine* for November 1852:

Thou rusty ruin—
Thou piece of fallen greatness, that no more
Thy flight pursuing,
Shall through the land like raging monster roar,
Or the deep bosom of the earth explore—
Thou look'st so quiet,
That we may scarcely deem that thou hast been
A thing of riot;
The foremost actor thou in many a scene,
Wherever tumult, sometimes slaughter's bean;
A monstrous flyer,
That swift as lightnings o'er the earth did sweep
On wings of fire,
Affrighting night—cleaving the darkness deep,
With trusting mortals, some in tranquil sleep.
And now art branded
As doubtful, dangerous; and thus cast away,
Like monster stranded,
To fancy's eye, upon the shoal decay,
Thou used-up screamer, that has seen thy day;
And never more
Shall the woods echo to thy fiend-like yell,
Nor thy uproar,
In caverns dark, ten thousand echoes swell,
Like fearful discord of tumultuous hell.
Hushed, and for ever,
Thy horrid voice—thy soul-appalling scream;
And thou shalt never
Fright Naiad more from fount or forest stream,
Or rustic rouse from sleepy hollow's dream.

Contributions.

Experiments with American Timber.

BANTOUL, Ill., Nov. 27, 1877.

TO THE EDITOR OF THE RAILROAD GAZETTE:

Please allow me space in your valuable columns for the results of some experiments made to ascertain the "coefficient of elasticity" (E), and the "modulus of rupture" (B).

Every engineer having occasion to use these constants too well knows the difficulty of finding them for American woods. These experiments were made in the physical laboratory of the Illinois Industrial University, under the supervision of Prof. S. W. Robinson, of that school.

In compiling this I have rejected such experiments as I thought differed too much from the mean. I am indebted to Prof. Robinson for his kindness in furnishing me the original notes.

H. C. ESTES.

SUBSTANCE.	No. of Experiments for E.	E.	No. of Experiments for B.	B.
American white oak	8	1,349 929	10	11,758
White pine	10	1,550,948	10	9,586
Black walnut	12	1,835,367	9	13,658
White ash	6	1,254,563	7	12,947
Poplar	7	1,465,725	6	8,207
Hard maple	1	1,835,800	1	15,524
Tennessee iron	6	28,046,811	.....	.....
Chrome steel	13	30,080,371	.....	.....

RAILROAD GAZETTE

Published Every Friday.

CONDUCTED BY

S. WRIGHT DUNNING AND M. N. FORNEY.

CONTENTS:

	Page.		Page.
ILLUSTRATIONS:		GENERAL RAILROAD NEWS:	
Tests of Salisbury Iron	539, 540	Elections and Appointments	545
CONTRIBUTIONS:		Personal	545
Experiments with American Timber	541	Traffic and Earnings	545
EDITORIALS:		The Scrap Heap	541, 546
Railroad Apportionment Schemes	542	Old and New Roads	546
Lubrication	543	ANNUAL REPORTS:	
Foreign Railroad Notes	544	Connecticut Valley	547
October Grain Receipts at New York	544	Boston & Maine	548
Record of New Railroad Construction	544	Galveston, Brazos & Colorado	548
EDITORIAL NOTES	544	Union, of Baltimore	548
NEW PUBLICATIONS	545	Boston & Providence	548
		Minor Massachusetts Railroads	548
		MISCELLANEOUS:	
		Salisbury Iron	539

Editorial Announcements.

Passes.—*All persons connected with this paper are forbidden to ask for passes under any circumstances, and we will be thankful to have any act of the kind reported to this office.*

Addresses.—*Business letters should be addressed and drafts made payable to* THE RAILROAD GAZETTE. *Communications for the attention of the Editors should be addressed* EDITOR RAILROAD GAZETTE.

Advertisements.—*We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay,* EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and those only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially, either for money or in consideration of advertising patronage.*

Contributions.—*Subscribers and others will materially assist us in making our news accurate and complete if they will send us early information of events which take place under their observation, such as changes in railroad officers, organizations and changes of companies, the letting, progress and completion of contracts for new works or important improvements of old ones, experiments in the construction of roads and machinery and in their management, particulars as to the business of railroads, and suggestions as to its improvement. Discussions of subjects pertaining to* ALL DEPARTMENTS *of railroad business by men practically acquainted with them are especially desired. Officers will oblige us by forwarding early copies of notices of meetings, elections, appointments, and especially annual reports, some notice of all of which will be published.*

RAILROAD APPORTIONMENT SCHEMES.

I.

There has probably never been in any country a competition for traffic between railroad companies so sharp and severe and at the same time so long continued as in this country. Indeed, railroad business here has been regarded substantially the same as any other business, by the community and the legislatures which represent it, at least until recently. First of all, there has been, generally speaking, no limitation to the construction of roads. Any one could build a road anywhere at any time, provided he could raise the money. Indeed, to most Americans this seems a matter of course. They can understand why the community or the government might take steps to multiply railroads, but they cannot imagine that it should deliberately aim to limit them. If an association of capitalists purpose to put their money into a road which cannot pay, that is considered to be entirely the affair of the capitalists, and not at all of the community; and if their line were projected to extend directly alongside of an existing railroad, and by dividing its traffic greatly reduce or perhaps wholly destroy the profits of the latter, the prospective injury to the old corporation would not generally be considered as any reason for the community to hinder the construction of the new line. The risk, it would be said, was one that the proprietors of the old road necessarily took; it adheres to their business as to most other kinds; they must not call upon the State to protect them from competition.

Now no such freedom of construction has been permitted anywhere else in the world. Even in England, the leading free-trade country, where the Government purposes to meddle as little as possible with the affairs of the people, charters are granted only after a searching examination, during which the arguments of the representatives of existing lines in the same district are heard; and the fact that the old line would suffer by the competition of the new is accepted as telling against the latter, though not necessarily decisive. But generally we may say that if it is shown that the purposed line will not afford considerable public advantages not given by existing roads, and is not likely to pay, Parliament will not authorize its construction. It will not protect the capitalist at the expense of the community; but you must show that you will afford important benefits to the latter before you are permitted to injure the property of the former.

This, it is true, has not prevented competition in England. It would be almost impossible to contrive a system of roads independent of each other which would serve that thickly-peopled island, crowded with great towns, without coming into competition at many points. And in the earlier days of English railroads there was often a severe competition, extending to rates; but it appears never to have been carried to the extreme length common in this country, and in these later days it has been greatly limited, partly by the "amalgamations" of roads into great systems, each with a considerable district pretty much to itself, only the borders of which are reached by competing lines, and partly by agreements among the companies, which the existence of the Clearing House makes it comparatively easy to enforce.

On the Continent of Europe the railroads have been, usually, under strict surveillance from their beginnings, and in many cases the avoidance of competition was expressly aimed at, a "regulated monopoly" being the ideal of the State and of the community, as in France.

There has thus been a reason why competition should have been greater here than elsewhere. Probably another reason exists in the very extent of the country and its railroads, as there are likely to be greater efforts to secure a through traffic which must pass over a line a thousand miles long, than for that which can go but two hundred miles.

That competition on railroads is naturally pushed to greater lengths than in other business we have endeavored to explain heretofore by the facts, that, in the first place, only a part of the business of the roads, and usually by far the least productive part, is subject to railroad competition; and, second, that, the roads being required and built to accommodate the way traffic, there are often several times as many as are required for the through traffic; and, finally, and chiefly, that in its nature a railroad is an instrument whose capacity is, or can easily be made to be, vastly in excess of any demands upon it, so that it always finds it advantageous to accept any *addition* to its ordinary traffic which pays any profit whatever over the expenses connected with it. These are facts of general application. Generally speaking on every railroad the supply of transportation is greatly in excess of the demand; at nearly all traffic centres there are several lines to carry the traffic, which would not require the full utilization of half the capacity of a single one of them; and each line being chiefly supported by local traffic accepts any addition which it can obtain either by the development of entirely new business or the diversion of old business from a rival, as desirable even if it yields but one-tenth of the average rate of profit.

Whatever the cause, competition on American railroads, and especially on the trunk lines and their immediate Western connections as far west as Chicago and St. Louis, has for many years been sharp and constant, and since 1873 has been carried to such an extent as to reduce rates, especially in 1875 and 1876, to figures before unheard of in the history of railroad transportation. This competition was by no means something new in the history of American railroads; it only reached its height in the years named, when the great multiplication of roads in the West had increased the number of competitors, and the great enlargement of capacity of the trunk lines made them more desirous than ever to increase their traffic, just at the moment business became paralyzed, when nearly all production except agricultural production decreased instead of increasing, and when the rate of increase in agricultural production even became comparatively small. Under these circumstances we saw last year the most important through traffic of the country carried for eight months at an average rate of about 0.4 cent per ton per mile, and passengers at 1½ cents per mile.

This extreme competition coming at a time when the total business was not increasing, or increasing much slower than formerly, and when the number of competitors for the traffic had increased, and each had a larger capital on which interest was expected, the results were very serious, and to some corporations deadly. It is not always possible to say how much of a company's misfortunes has been due to the reduction of rates by competition and how much to the reduction of traffic by the multiplication of lines. But there can be no doubt that enormous losses have resulted from the unduly low rates on many roads. The total cessation of dividends on such roads as the Michigan Central, the decrease from 8 to 4 or 2 per cent. on the Lake Shore & Michigan Southern, and from 10 to 8 and 6 on the Pennsylvania, the inability of the Atlantic & Great Western and the Erie to pay interest on the bonds, and many similar cases, have been due, chiefly or wholly, to the excessive competition; for on nearly all roads of this class traffic has not decreased since 1873, but has increased, though not as fast as it was expected to nor as it had been doing before 1873.

Thus the railroad companies of this country have had full experience of the direful effects of unrestricted competition. Gradually the conviction has spread—early with some managers and late with others—that if any profit were to be had in the future from through traffic, if that great business, which on several lines requires more than half of the trains, was to contribute anything towards the interest invested in roads and rolling stock, some method must be provided for avoiding or restricting this competition. Efforts to maintain agreed rates and to continue competition at the same time have been made from the first, but never with anything more than temporary success. Next we have had contracts and organizations with some kind of central or common authority to maintain rates while still competing, such as the one in New York many years ago under the supervision of Samuel Sloan, and the late organization under the "Saratoga agreement."

Recently, however, the remedy for competition resorted to has been the agreed division of the traffic competed for or of the gross or net earnings from such traffic, intended to take away all motive for competition.

These apportionments, or "pools" as they are more commonly called, are now applied to a vast amount of traffic on scores of railroads, and they are being studied by many competing companies which have not yet adopted them. The question is not fully solved when the different parties have agreed upon the proportions which they are willing to accept. It remains to devise the method of dividing, the machinery by which the scheme is to be carried out.

We shall not attempt here to show what is the best way to carry out such a plan for dividing traffic or earnings, nor even to point out the special difficulties in the way, to be provided against. Our aim is simply to set forth briefly the principles on which the chief existing schemes are based, and the machinery, so far as it is known, by which each is carried out.

THE OMAHA POOL.

The oldest apportionment now in operation, so far as we know, is what is known as the "Omaha pool," formed by the three direct lines between Chicago and Council Bluffs connecting with the Union Pacific Railroad, over which most of the California traffic passes. These three roads were all opened to their connection with the Union Pacific not long after that road was completed and the California traffic began. They were very nearly of equal length—all between 490 and 500 miles; they were so similar in accommodations afforded that none could expect permanently to attract more traffic than another. For a time after the opening of the railroad to the Pacific, extravagant expectations were entertained of its traffic. Many railroads besides those connecting directly with the Union Pacific made special efforts to secure a share of the business. Railroad agents were sent to San Francisco by the score, and some even to China and Australia. A year or two showed that the whole traffic was small, and we have been told that in some cases the cost of getting its Pacific business cost the road more than its *gross* receipts therefrom. Competition, however, never affected the rates on this business, we believe, to the extent that has been known in many other cases elsewhere. But what with the increase in expenses, the inconsiderable traffic and the reductions in rates, it bid fair to make this business a very small source of profit, even if it should be profitable at all.

Then, when the Pacific railroads had been completed about two years, in the fall of 1870, the three lines between Chicago and Council Bluffs—the Chicago & Northwestern, the Chicago, Rock Island & Pacific, and the Chicago, Burlington & Quincy—formed what has since been known as the "Omaha pool." The principle of the division was that each road should have an equal share of the profits on the traffic, both freight and passenger, between Chicago and Council Bluffs. It was assumed that the working expenses of this traffic were 45 per cent. for passengers and 50 per cent for freight. Deducting this from the gross earnings, the remainder, that is, 55 per cent. of the passenger earnings and one-half of the freight earnings, was divided equally among the three roads.

The arrangement between these companies was a simple verbal agreement; the machinery for carrying it out was *nil*. The circumstances were remarkably favorable for carrying out an agreement for division. As we have said, the lines were of almost equal length, and similar in quality, and their managers recognized the fact that they had substantially equal advantages for traffic; these managers and the other chief general officers of all the roads were all in one city, communicating frequently with each other and having confidence in each other. The business itself was a simple one, all received and delivered at the two termini, Chicago and Council Bluffs. The managers were determined to carry out the agreement if it were in any way practicable. They were not, however, fully confident of success, and for some time it was felt necessary to remain prepared to resort to the old machinery of competition. But as time passed and the possibility of success grew evident and perfect good faith was maintained, confidence in the permanence of the arrangement increased, while the demonstrated advantages of it made all the parties more and more anxious to maintain it.

Modifications were made in the arrangement from time to time, the chief of which were introduced in 1874, when it was agreed that the *gross* earnings from all passenger traffic eastward and that part of it westward which originates in Chicago should be divided yearly, while each company would reserve to itself 45 per cent. of the earnings from pas-

senger business originating east of Chicago. The latter was excepted because two of the lines were compelled to keep up agencies in the East on account of their Southwestern business, and an allowance of 55 per cent. for expenses gives these agencies some inducement to solicit traffic. This arrangement enabled the three companies to maintain but one passenger agent for them all at Omaha and San Francisco, and left no temptation to pay commissions or make other efforts to secure passengers to one line rather than to the others. No matter how large a proportion of the east-bound passengers a road may get, it will not receive a cent more than they. It is really to its interest to carry as few as possible rather than as many as possible, as there must be some increase of expense and risk with the increase in number, and no allowance for it whatever. Practically, however, the traffic divides itself very equally, both passengers and freight, and this being the case the proportion withheld as expenses is immaterial. While in form a division of net earnings, under the circumstances it works like an apportionment of traffic.

The three main lines from Chicago to the East—the Michigan Central, the Lake Shore & Michigan Southern, and Pittsburgh, Fort Wayne & Chicago—deliver their freight bound to Council Bluffs and west to these three roads in the pool, each eastern road giving all its freight for one week to one of the pooled lines, then for a week to the second, and so on, which is another aid to the equal division of traffic, especially since the establishment of the New York apportionment, which, by the way, distributes the Pacific business differently from other business.

Here we have a combination for the division of net earnings, which has lasted seven years and more with inconsiderable changes, and now seems more firmly established than ever. It has lived through the heat of the Granger agitation, a time of great prosperity, and a season of great depression. All the time rates have been maintained, with few and slight changes, so as to return reasonable profits. One of the first things observed when the arrangement was planned was that the rates must be reasonable. And this was not simply because the public would not readily endure a combination which aimed to collect exorbitant prices from it; that it would consider, and properly, a conspiracy; it was also because what might escape the attention of one, or not provoke much objection on one line, would be much more likely to be objected to when discussed by three.

Perhaps the most notable feature connected with this arrangement has been its acceptability by the community to which it especially applies. There can be no doubt that the rates from Chicago to Council Bluffs and Omaha have been kept higher than they would have been otherwise, by the operation of this combination. Yet there is scarcely any other station on the three roads where the relations between the shippers and the railroads are so satisfactory. The merchants can depend upon the rates, for they are steady; they know that they get just as good terms as their competitors in business, instead of suspecting (or more) that when they compete with a rival house they have to fight a railroad company as well as a business firm. What they watch for is to see that no rival town has the advantage of theirs in rates, which the railroads also are interested in preventing. The community has had steady, impartial and reasonable rates, and has been satisfied. And the rates have been reasonable not only to the people of Council Bluffs and beyond, but to those between Council Bluffs and Chicago, who but for this arrangement would probably have to pay the entire cost of supporting the 1,500 miles of railroad which do the carrying for the country west of the Missouri; and, finally, they have been reasonable also to the people of Holland, New England and New York, whose hard-earned savings are invested in these roads.

LUBRICATION.

There are two subjects, somewhat allied to each other, concerning which a very dense state of ignorance still seems to prevail among both scientific and practical men. These subjects are lubrication and the resistance of trains. The reason for this lack of knowledge is probably because they cannot be investigated thoroughly without greater cost than investigators, who are usually impecunious, can afford, or without the co-operation of some company, which the investigator can't get. Corporations, which are often most largely interested in the results of such investigations, are entirely inefficient in making scientific researches. Although they may sometimes be induced to aid and even to co-operate with individuals in making such investigations, yet their patronage is usually difficult to secure. Railroad companies have therefore gone on year after year in ignorance of matters which were costing a great deal of money, much of which could probably have been saved if there had been more knowledge concerning them.

Considering how little is known about lubricants and lubrication, it seems to be a very proper subject to bring up for discussion at the meeting of railroad men which is held every month at the rooms on Liberty street, New York. Whether we look at it from the practical or theoretical side, we find the same degree of ignorance prevailing in regard to it. A short time ago the writer inquired of a master mechanic who has had charge of the machinery of a prominent railroad for many years how they determined the quality of oil which should be used. "Well," he replied, "usually the Purchasing Agent buys a lot of oil, and after we have used it a while he asks me whether we have any hot boxes; if we have not, then it is all right; but if we have, then he gets some other kind of oil." Now this is a very simple method, and has a plain, practical, common-sense look about it which is attractive; but it can readily be seen that it might be, and probably would be, very misleading in many cases. Any one who has had experience in such matters must have learned what an extremely uncertain guide mere personal observation is without some exact record to determine the opinion of the observer. It is almost inevitable that he will allow irrelevant matters to get mixed up with the motives which determine his opinions. Thus some day an important train will be detained by a hot box and a prominent official will complain. Now the master mechanic is thus made to feel the evil of that one hot box more than many others which did not occur on trains of equal importance and about which there were no complaints. Owing to the vexation and annoyance produced by this one occurrence, the oil used at that time may be condemned, when possibly the case which gave so much trouble may be only one of a very few, and the oil may in fact be doing very well, and it would so appear if an exact record of the hot boxes was kept. Under the circumstances named, a master mechanic or any other officer is very apt to allow the degree of the annoyance experienced to affect his estimate of the value of the oil, when probably the two had no connection whatever with each other.

In making estimates or comparisons of any matters it is important that some exact measure should be established. Any one who reads the report on Salisbury iron, part of which is published on another page, will see that even in so apparently simple a matter as that of determining the value or the quality of cast iron, several distinct measures must be established. Thus there is the "modulus of rupture," of "proof stress," of "elasticity," and of "resilience." All these have been adopted to measure certain qualities in the metal. Now in the same way there should be a modulus of hot boxes, although we would not recommend the use of so high-sounding a term. In the monthly locomotive returns published in these pages, there are several moduli or measures used. Thus we have the number of miles run per ton of coal, cord of wood and pint of oil. Now these might be called the moduli of fuel and oil consumption. Of course any other measure would do as well. The consumption of oil might be measured by the number of miles run per gallon of oil, or per litre, if our metrical friends succeed in having their way adopted.

We took occasion in a previous number of calling attention to the fact that the rolling stock of a railroad is the best and most reliable oil-testing machine. Not that the more delicate instruments have not their use for purposes of comparison, but that the final determination of the value of a lubricant should be made on the rolling stock of a road. The difficulty in most cases is that no record, or at least no correct or complete record, is kept of the indications of this great testing machine, which is in daily and constant use. Now what is needed is, in the first place, a careful record of the number of hot boxes on all the rolling stock; next, the mileage of all the vehicles on the road, then a monthly report of the number of hot boxes, from which it would be easy to calculate the number per thousand miles run by say freight and passenger cars, engines and tenders. This number per thousand miles run would be the "modulus" of hot boxes.

Probably there is hardly a railroad manager in the country who is not constantly annoyed by the frequent occurrence of hot boxes; certainly few passengers who go away far from home avoid delay and vexation from that cause. Now what is needed, if not to cure at least to mitigate the evil, is first to learn exactly the extent and limitations of the evil. To do this accurately it will be necessary to keep a correct account of the mileage of the cars. At present there is a movement on foot to secure the general adoption of a system of keeping account of the actual mileage of all cars. Possibly a statement of what could be learned about lubrication might be some additional inducement to lead railroad managers to adopt such a system.

As we took occasion to state in an article on hot boxes in the *Railroad Gazette* of Aug. 31 of this year: "at first the whole question of lubrication seemed to be one of oil alone. If a journal heated, it was attributed to the oil—often, no doubt, properly so; but perhaps quite as many times the trouble was then, and is now, due to other causes." Now if a careful account of what is called the "individual" mileage of cars, and at the same time of the hot boxes and of the cars on which they occur, is kept as stated, the number of hot boxes per thousand miles run could then be easily calculated. One of the great difficulties in railroad management is that, owing to the immensity of the detail connected with the business, it is impossible for a manager to know what is transpiring on his road. Reports reach his ears about the delays from hot boxes, until finally he calls some one or more of the officers to account; but in order to get at the truth of matters relating thereto, he must listen to long explanations why one thing occurred, and reasons and excuses for the non-occurrence of something else, until finally the difficulties in the way of his effecting a reform become greater than the time he can give to them, and he succumbs in a sort of hopeless way to what seems inevitable. But suppose a monthly report is made of all the hot boxes on the road, and this report is handed to him. Now this is very much better than no account at all, because it is capable of comparison from month to month; but suppose that in November the number of hot boxes suddenly rises, and attention is called to it, the excuse might be that owing to the increase of business there was a much greater mileage of cars. But how much greater? Without some accurate figures or data it will be impossible to say how much was due to the increase of mileage, and how much to other causes. If the mileage of cars was correctly kept, and the number of hot boxes per thousand miles run was reported, then the manager would have a correct measure or "modulus" of this evil. If there was an increase or diminution in it from month to month, by having some such accurate measure of the evil he would be in a position to trace out the cause with much greater certainty, and of holding those who are responsible to a much stricter accountability. The rolling stock of a railroad would thus become an enormous oil-testing machine, and the monthly or weekly report of the modulus of hot boxes would be as sure an indication of the quality of the oil used as the position of the mercury in a thermometer would be of the temperature of the bulb below. When the report came in no explanation or reasoning on the circumstances would be needed to determine the facts; the figures themselves would represent them. If when Stickum & Co. supplied the oil the number of hot boxes per thousand miles run increased, and when the lubricant used came from Oleajynus & Grezy they decreased, then the figures might be regarded as cause and effect.

As we remarked before, lubrication is not a question of oil alone. It is a question of the materials in contact, the quality of the bearing, and of the journal. The discussion of the relative merits of the big journals and the little ones has gone on for years, and, incidentally, it may be said that those who at first favored a large journal now favor a larger one, whereas some of the small-journal men have sensibly weakened in their faith in the traditions of the past. The form and proportions of both the journal and its bearings are of very great importance; the value of soft metal linings is much discussed; there is some dispute about the use of end bearings. Of different kinds of dust-guards there is a number which at present we cannot count, and the disputants about the relative merits of steel and iron axles are about equally divided. In this country a common form of axle-box is almost universally used, but in Europe there is great variety in the construction of these parts. Then bad workmanship we always have with us. Now all these subjects are represented by unknown quantities, which need to have values assigned to them. The one sure method which is open to all railroad companies to determine such matters with certainty is, to keep correct records and make accurate reports of the number of hot-boxes, and the cost of lubrication. If this were done, and the question came up with reference to the relative advantages of steel and iron axles, it would be a comparatively easy matter for the person having charge of such accounts to separate the reports, so as to show the number of hot-boxes per thousand miles run on the cars equipped with say steel axles, and those equipped with iron axles. Or if big journals and little journals, which form the bone of contention coming up annually in the Master Car-Builders' Convention, should need light shed upon them, all that would be needed would be to observe from month to month what the modulus of hot boxes indicated for cars equipped with that kind of axle. Unanswerable arguments could be presented to the manufacturers and compounders of anti-friction metal for journal bearings, and possibly we should find that our present form of journal box is far from being the best that can be devised.

A reliable and accurate monthly report of the number of hot boxes per thousand miles run for the different classes of cars employed, with the cost of lubrication adjoining, would have about it somewhat of the character of inexorable justice. It would, we believe, serve to railroad men in their business a purpose analogous to that of the fatal pin to the entomologist in the pursuit of his science: the monthly report would impale some of the choicest specimens of the genus humbug that now make the lives of railroad officers unhappy and are apt to become leeches on the treasury of the company which it is the duty of its officers to guard.

Now in what has been written there was no intention of undervaluing scientific researches and investigations in the perplexing subject of friction, lubrication and lubricants. Such researches, if conducted at all by corporations, must be delegated to individuals, which is already

done on some roads; and probably one of the great instrumentalities for the advancement of science in future will be the patronage which will be given intelligently by large corporations. What we want to point out is that every railroad company has—without going into what to most railroad men are unfamiliar fields of science—an unerring guide for determining matters which are now so little understood and which cost so much money.

The discussion of the subject at the rooms of the Car Builders' Association in Liberty street will probably take a somewhat different direction from that indicated above, and will be a sort of co-operative movement made by practical in conjunction with scientific men, which will doubtless be suggestive of much that will lead to a better understanding of the subject.

It might be added that, owing to the use of four-wheeled cars on some roads and also of four and six-wheeled trucks, probably in order to secure an accurate measure of hot boxes it should be kept on the basis of *axle* instead of car mileage. On German railroads the reports are generally given in this way, so as to equalize the four and six-wheeled cars used there.

Foreign Railroad Notes.

A German steel works (Bochum's) has recently taken a contract for 6,500 tons of steel rails, to be delivered at Barcelona, Spain, at a price equivalent to less than $30 at the works.

A station yard at Pesth, Hungary, has all its tracks, including switches and crossings, laid on iron supports designed by Serres and Battig, and manufactured in Belgium. These are said to be the only iron substitute for ties which can be used for switches, etc. That most used in Europe now is the "Hilf" system, with which a considerable mileage of road is already laid in Germany and Belgium. The Indian Government is now negotiating for some iron substructure for 175 miles of metre-gauge railroad, but it has not decided what system to adopt. A great many systems have been tried in India, where wood is destroyed very rapidly, but none, it is said, has been satisfactory, the weak point usually being the connection with the rail.

The demand for iron is reported to have improved considerably in Belgium, and one steel works is said to be declining orders, as it has all it can execute until next July.

The Russian Government is negotiating for the purchase of 130 locomotives and 1,750 freight cars, to be delivered by the first of May next. It was expected that Belgian works would get contracts for 50 of the locomotives and 1,200 of the cars.

The "Central Railroad Commission," which was established in 1872 by the Minister of Public Works of France, was reconstructed by a decree issued Aug. 11. This Commission is to consider and report upon all questions concerning the granting of charters, the construction and the operation of railroads. The Minister, on account of the increasing importance of railroad questions, has increased the number of members of the Commission, and has declared that, in regard to the present public agitation concerning the question of rates, the administration would introduce the most important reforms demanded by commerce, within the limits of the existing contracts between the State and the companies, especially with regard to uniformity and simplicity. A sub-committee was appointed to investigate these subjects.

The Italian railroads, with an average length of 4,904 miles in operation, earned $14,583,638, or an average of $2,974 per mile, during the first half of this year. The increase in mileage was about 3 per cent., and in earnings about 6 per cent. in comparison with the corresponding half of 1876.

October Grain Receipts at New York.

For the month of October the receipts of grain and flour (flour reduced to bushels) at New York by different routes have been for four years:

By railroad:	1877.	1876.	1875.	1874.
Pennsylvania	625,732	768,608	633,972	921,750
New York Central & Hudson River	3,904,475	2,798,836	1,929,767	1,364,981
Erie	2,241,938	1,599,203	2,196,680	1,106,661
Other roads	9,039	8,535	11,990	9,776
Total by rail	6,781,114	5,175,182	4,772,399	3,403,168
By Water:				
Coastwise	264,060	211,828	152,350	151,654
North River boats	10,578,406	6,885,115	7,639,052	7,064,307
Total by water	10,842,466	7,096,943	7,791,402	7,215,961
Total rail and water	17,623,580	12,272,125	12,563,801	10,619,129

The percentages by rail and water have been:

	1877.	1876.	1875.	1874.
By rail	38.5	42.2	38.0	32.0
By water	61.5	57.8	62.0	68.0

It thus appears that at rates fully twice as high as those of last year the trunk lines very nearly kept up last year's proportion of the grain shipments to New York and obtained a larger proportion than in any previous year, while the *quantity* carried by rail this year was nearly one-third greater than last year. The gross receipts of the three trunk lines for carrying grain to New York in October must have been about 165 per cent. greater this year than last. Their net earnings from this traffic for the two years can hardly be compared, for there were none last year. This year the New York Central & Hudson River carried 57⅛ per cent. of the total rail grain; last year, 54 per cent. The Erie's proportion has increased from 31 per cent. to 33 per cent.; the Pennsylvania's has decreased from 15 to 9¼.

At current rates the October business this year must have given the three roads (east of Buffalo, Erie and Pittsburgh) a gross increase of something like $650,000 this year and $250,000 last. The lines between Chicago and Buffalo and Pittsburgh have carried much less grain than last year so far, the supplies of the trunk lines coming very largely from their propellers on the lakes. That is, the railroads this fall have been able to compete very effectively with the Erie Canal, but not with the lake vessels.

Record of New Railroad Construction.

This number of the *Railroad Gazette* contains information of the laying of track on new railroads as follows:

Chicago, Milwaukee & St. Paul.—The *Necedah Branch* is completed from Lisbon, Wis., north to Necedah, 12 miles.

Fond du Lac, Amboy & Peoria.—Extended south 7 miles to Iron Ridge, Wis. It is of 3 ft. gauge.

This is a total of 19 miles of new railroad, making 1,964 miles completed in the United States in 1877, against 2,153 miles reported for the corresponding period in 1876, 1,176 in 1875, 1,731 in 1874, 3,456 in 1873, and 6,559 in 1872.

THE CHICAGO LAKE COMMERCE for the season up to December includes arrivals of 9,898 craft with an aggregate capacity of 3,263,141 tons, and clearances of 10,030 craft whose tonnage was 3,302,802. The number of arrivals and departures is said to be greater than at the port of New York, and their aggregate tonnage to be fully equal. The Chicago season, however, is nearly at an end with November, and is but about seven months long, while the New York season of course lasts all the year round. There are few who have an adequate idea of the extent of the lake marine, or of its importance to the country. It has done a profitable business for about four months of this season, but for two seasons or more before it has on the whole made no profits, while performing great and valuable services. Meanwhile this unprofitableness of vessel property has naturally led the owners to refrain from replacing craft which were lost, and the *number* of vessels on the lakes is doubtless less now than a few years ago. It may be, nevertheless, that the *capacity* is as large as ever. It is the smaller craft which are most unprofitable, and it has been claimed that even at the lowest rates there has been some balance of profit for the largest vessels. Thus there have been some new vessels under construction all the time, and these generally of large capacity. This general introduction of large vessels and steam barges, working more economically than the average craft of former days, makes it reasonably certain that the lake rates will never in the future reach the prices which they have sometimes commanded heretofore, and that the railroads will have permanently to meet a stronger lake competition. Since July, for instance, lake rates have been considered profitable, and the railroads from lake ports eastward have received comparatively little grain, though for part of the time at least their rates left a very narrow margin of profit. Evidently the time has not yet come when such articles as grain, iron ore and coal can be carried long distances by rail as cheaply as on the open lakes, and there are no present indications that the day is near. No more may be charged for the work sometimes, as was the case in 1876, but it costs more to do, and is likely to. The vessel-owners are quite satisfied with four cents a bushel from Chicago to Buffalo, which by the shortest rail route is equivalent to 0.267 cent per ton per mile, which is about one-third of the average *cost* on the railroads between Chicago and Buffalo.

THE PRIMARY DISTRIBUTION OF PETROLEUM is shown more clearly by the statistics of shipments from the oil regions than from the figures for the exports from the various ports to which we made reference recently. These statistics of shipments with the amounts consigned to each destination we publish under the head of traffic and earnings for the months of September and October for two years. We should look to the comparative shipments in September and October of this year to ascertain the effects of the compact of the railroad companies and the Standard Oil Company. The proportions of the total shipments directed to the leading points below named were as follows in the two months:

	September.	October.
New York	46.6	40.3
Cleveland	26.2	33.1
Pittsburgh	14.7	10.3
Philadelphia	6.6	6.3
Baltimore	0.5	0.5

As this includes only the shipments of crude from the oil regions, it is rather a clue to the refining business of the cities named than of their receipts. Evidently, most of the receipts at Philadelphia and Baltimore at least are of refined coming from Cleveland and Pittsburgh. So far as the above table indicates anything, it is that Cleveland, the headquarters of the Standard Oil Company, gained largely at the expense chiefly of New York and Pittsburgh. The Cleveland refined oil may go to any of the ports equally well, and that exported could be thrown upon any one of the trunk lines if there were not an agreement to divide it. With receipts of 6,000 car-loads a month, and a large proportion of that to send east when refined, it is not strange that its traffic should be eagerly sought for.

THE FRENCH RAILROAD SYSTEM may be said to consist of three classes of lines—first, a system of trunk lines, excellently constructed but costly, with a large traffic carefully protected from competition, and returning large profits to its proprietors; secondly, a secondary system, chiefly connected with the trunk lines, but with a comparatively very small traffic, returning very small net earnings and largely supported by the Government, as their profits do not amount to more than 1 per cent. on their cost; and, third, of a number of still less important lines, generally serving for local traffic, and called "railroads of local importance." Now the second system has cost about as much per mile as the first, though the traffic which it has to accommodate is in no way comparable. In the third system alone seems cheapness to have been aimed at, or any particular adaptation of the road to the amount of traffic, and the average cost of these has been about $38,200 per mile. During the first quarter of this year the net earnings of 26 of these roads, whose aggregate length was 452 miles, was at the average rate of $96 per mile, which if kept up through the year would yield about 1 per cent. on their cost.

The difficulty in France seems to be that the roads are built and worked too nearly on a uniform model, for which the great lines serve. Regulations concerning speed, watching roads, station service, perfection of construction, rates for fare and freight which may be wholly justifiable on a great line with many trains daily may be simply absurd when applied to lines which cannot get traffic enough to fill a light train each way daily, and which could answer all reasonable requirements at a speed of fifteen miles an hour. The centralization of the railroad managements and supervision checks that individual development of railroads which fits each as nearly as possible to its particular circumstances. France has now a smaller railroad mileage in proportion to its population and production than the other leading European countries, and still it seems unable to provide for the requirements of its people in such a way that the new roads will earn interest on their cost.

BRITISH RAIL EXPORTS, the amount of which usually gives some clue to the activity in railroad construction in the rest of the world, show a very decided increase this year over last—for the ten months ending in October about one sixth, and for October nearly one half. The increase is only significant of a turn in the tide, not at all of good business, for last years' exports were very unsatisfactory. The matter does not concern this country particularly, for we have practically ceased to import rails, but England is almost the sole source of supply to other countries out of Europe, and to some in Europe. This year British India has been its best customer, taking 19 per cent. of its total exports; next comes Russia, which took 17 per cent.; then Australia, Sweden and Norway, and British North America. British colonies took 183,500 tons, enough to lay 2,085 miles of track with 56 lb. rails, and 43¼ per cent. of the total exports. Thus it may be said that the British Empire now manufactures rails chiefly for its own consumption Its total exports this year are not likely to be more than half as great as the production of rails in this country. Doubtless, so far as capacity of works is concerned, this country could now supply the demand of the whole world outside of Europe without any special effort or preparation. Things will have to change, however, even more than they have changed, before it can supply these rails at $35 a ton, as England is doing.

PRICES OF RAILS IN GERMANY have been compiled by the Statistical Bureau of Prussia (and of many other railroad materials) for a period of four years, so far as such prices are ascertainable from the public lettings of contracts, which are much more common than here. Those prices for Bessemer and iron rails were, per ton of 2,240 lbs., at the beginning, middle and end of each year since 1872, as follows:

	—Beginning—		—Middle—		—End—	
	Bessemer.	Iron.	Bessemer.	Iron.	Bessemer.	Iron.
1873	$103 00	$88 40	$97 00	$83 75	$87 50	$60 50
1874	88 00	71 00	73 70	47 85	65 00	45 00
1875	64 40	46 75	52 60	43 25	48 35	43 25
1876	46 60	37 80	41 80	37 00	43 85	41 80

The same Bureau gives as approximately average prices in England in 1873 and 1877 as follows:

	1873.	1877.
Iron rails	$75	$40
Steel rails	105	35

We do not know what authority the Statistical Bureau could have found for stating the price of iron in England higher than steel this year. Recently, Mr. Isaac Lowthian Bell stated that steel was but $2.50 higher than iron, but it is hardly probable than any iron can be sold for *more* than the price of steel.

COLOR BLINDNESS is a subject of investigation in employing new men on one of the great French railroads, with results that indicate that it is decidedly dangerous to employ any man who has to observe signals without first testing his ability to distinguish colors. On this road 1,050 men, aged from 18 to 50 years, were examined from July, 1873, to October, 1876. They were shown objects colored violet, green, blue, yellow and red. Of 1,050 98, or nearly 10 per cent., mistook at least one of these colors. The errors made were:

Concerning	violet	78
"	blue	50
"	green	54
"	yellow	14
"	red	10

Twenty-nine of the number gave correct answers "after repeated hesitations" and eight others corrected their mistakes afterwards, and only 11 of the whole number were rejected for color-blindness. As on this road examinations for color-blindness have been made since 1855, all the candidates were probably aware of the requirement, and none but those unaware of their defect were likely to apply. Ability to distinguish red is alone absolutely required of all employes, at present.

THE RAILROAD POSTAL SERVICE at the end of June last, according to the Postmaster-General's report, was performed over 74,546 miles of railroad, or rather of routes, some short sections of railroad doubtless serving for more than one route. The cost of this service was $9,053,936, which is at the average rate of $121 per mile of route and 10¾ cents per train mile. Probably as much as 90 per cent. of the entire mail transportation is done on these railroad routes, which received 28 per cent. of the total disbursements of the Department for their compensation, and about 60 per cent. of its total disbursements for carrying the mails. The increase in length of railroad routes during the year was 2,198 miles.

THE DECEMBER MEETING OF RAILROAD MEN AND "OTHERS," as we have announced heretofore and hope our readers in and near New York will not forget, will be held at the rooms, No. 113 Liberty street, New York, Thursday, Dec. 20, at 7 p. m. The subjects for consideration and discussion will be "Friction, Lubrication and Lubricants." Professor Thurston has promised to be present, and to talk about these subjects, and will illustrate his remarks with his oil-testing machine and other instruments. The meetings are open to all who desire to attend.

NEW YORK GRAIN RECEIPTS were very much larger for the last week reported (ending Nov. 24) than for any other this year, and more than twice as great as its average receipts since navigation opened. They amounted very nearly to 4,500,000

bushels, and to 77.7 per cent. of the total sea-board receipts during the week. The proportion as well as the amount is the largest of the year, and, we think we may say, of the past two years. The grain came chiefly by canal, though at that time canal rates were about as high as rail rates.

NEW PUBLICATIONS.

Tunneling, Explosive Compounds and Rock Drills is the title of the work which Mr. Henry S. Drinker has prepared and which is now in the press of John Wiley & Sons. It is to form a quarto volume (pages a little smaller than those of Webster's Unabridged Dictionary) of 800 pages, illustrated by 1,000 engravings in the text, besides many plates, etc. We have heretofore had occasion to mention this work. An enormous amount of labor has been expended upon it, not only by Mr. Drinker, who has special qualifications for the task which he has set himself, but also by many other engineers, for Mr. Drinker has secured the co-operation of a very large number of engineers who have had experience in tunnelling and blasting. Wherever possible, he has obtained his information concerning important works from the men who conducted them. Thus in the chapter on the Hoosac Tunnel there are geological notes by Edward S. Philbrick, late Consulting Engineer; a working profile showing the monthly progress from the beginning of the work to the conclusion of the Shanley contract, by Mr. Philbrick and Mr. Benj. D. Frost, late Superintending Engineer; notes on the history of the tunnel by Thomas Doane, formerly Chief and afterward Consulting Engineer, and notes on machine drilling in this tunnel by Mr. Walter Shanly, the contractor.

We have before mentioned the completeness aimed at by the work. The author has intended to give a full history of tunnelling, so that all the processes used or that have been used may be made plain to the inquirer, while the more important modern works are to be described in detail.

The prospectus and table of contents give promise of an extremely interesting and valuable work. It is expected to appear about the beginning of next year. Subscriptions for the work (price fifteen dollars) are now invited.

General Railroad News.

ELECTIONS AND APPOINTMENTS.

Buffalo & Southwestern.—The bondholders who bought the Buffalo & Jamestown road at foreclosure sale met in Buffalo, Dec. 3, and organized a new company under the above name by electing the following directors: Abram Altman, George Beals, W. S. Bissell, M. N. Jones, Henry Kip, Henry Martin, John F. Moulton, W. H. H. Newman, George Talbot, J. W. Tillinghast, Buffalo, N. Y.; L. S. Jenks, Gowanda, N. Y.; Richmond Kingman, Cummington, Mass.

Cayuga Southern.—The officers of this road are: Agent for Purchasers, R. A. Packer; Superintendent, W. Stevenson. Offices at Sayre, Pa.

Chicago, Burlington & Quincy.—Mr. George O. Manchester has been appointed Assistant General Superintendent. Mr. Manchester has been on the road for eight years past, first as Chief Clerk under Mr. Perkins, then as General Ticket Agent of the Iowa lines, and lately as Secretary to General Superintendent Strong.

Connecticut Western.—Mr. J. F. Jones has been appointed Superintendent, and on and after Dec. 1, 1877, will assume the combined duties of Superintendent and General Freight Agent of this road. Mr. Jones has been General Freight Agent for some time, and was formerly Superintendent for the bridge-building firm of A. D. Briggs & Co., of Springfield, having had large experience as a civil engineer.

Covington Columbus & Black Hills.—Mr. D. E. Davenport having resigned the position of General Manager and Treasurer, S. C. Williams has been chosen Treasurer, and General Superintendent Meckling will perform the duties heretofore devolving upon the General Manager.

Fond du Lac, Amboy & Peoria.—Mr. H. W. Baldwin is President and Manager, with office at Fond du Lac, Wis.

Erie & Western Transportation Company.—The transfer of the Empire Transportation Company's property and the resignation of its officers have made necessary a reorganization of this company's business. Mr. H. Churchman has been appointed Auditor and Acting General Freight Agent, with office at No. 1,127 Girard street, Philadelphia. Mr. John E. Payne is Eastern Manager Anchor Line, with office at Erie, Pa., and will have charge of the movement and delivery of freight to points east of Erie.

International Ocean Telegraph.—At the annual meeting in New York, Dec. 4, the following directors were chosen: Harrison Durkee, Cyrus W. Field, Norvin Green, Cambridge Livingston, Wm. Orton. B. H. Rochester, E. S. Sanford, Augustus Schell, James Scrymser.

Logansport, Crawfordsville & Southwestern.—Mr. W. F. Smith is appointed Auditor, in place of W. D. Ernst, resigned.

Louisville & Nashville.—Mr. N. B. Thompson is now Master Mechanic of the Nashville & Decatur Division. Mr. W. J. Steele is Master Mechanic of the South & North Alabama Railroad, with office at Birmingham, Ala.

Marietta & Cincinnati.—Mr. Harry McKee has been appointed Purchasing Agent for the Receiver. Mr. Wm. H. Trego has been appointed General Superintendent of Express; he holds the same position on the Baltimore & Ohio.

Mississippi & Tennessee.—The old officers have been re-elected for the ensuing year, as follows: H. S. McComb, President; F. M. White, Vice-President; M. Burke, Superintendent.

Montgomery & Erie.—The following officers have been re-elected for the ensuing year: J. M. Wilkin, President; R. M. Vail, Vice-President; W. J. Mead, Secretary; C. J. Everett, Treasurer. The road is leased to the Erie.

New York & Long Island Bridge.—The following officers have been chosen for the ensuing year: President, Dr. Thomas Rainey; Secretary, R. M. C. Graham; Treasurer, Henry C. Schmidt.

New York & New England.—At the annual meeting in Boston, Dec. 4, the following directors were chosen: George W. Baldwin, Wm. T. Hart, Lewis Hecht, Edward W. Kinsley, James Sturgis, Wm. W. Tucker, Boston; George M. Rice, James Roosevelt, Worcester, Mass.; Jesse Metcalf, Gorham P. Pomeroy, Providence, R. I.; Frederick J. Kingsbury, Waterbury, Conn.; George S. Moulton, Windham, Conn.; Legrand B. Cannon, R. Suydam Grant, New York; Thomas Dickson, Scranton, Pa.

Old Colony.—At the annual meeting in Boston, Nov. 27, the following directors were chosen: Uriel Crocker, Francis B. Hayes, Onslow Stearns, Boston; Charles F. Choate, Cambridge, Mass.; Frederick L. Ames, Easton, Mass.; T. J. Borden, John S. Brayton, Fall River, Mass.; S. L. Crocker, Taunton, Mass.; Jacob H. Loud, Plymouth, Mass.; George Marston, New Bedford, Mass.; Royal W. Turner, Randolph, Mass.; Ephraim N. Winslow, Hyannis, Mass.; Elisha W. Willard, Newport, R. I. The new directors are Messrs. Marston and Willard, who succeed Benjamin Finch and Prince S. Crowell, both of whom declined re-election. The board subsequently elected Charles F. Choate President and George Marston Clerk. Mr. Choate succeeds Ex-Governor Onslow Stearns, who declined re-election on account of ill health.

Pittsburgh & Connellsville.—At the annual meeting in Pittsburgh, Dec. 3, the old board was re-elected, as follows: W. S. Bissell, G. L. B. Fetterman, Wm. Baldwin, Charles Donnelly, John D. Scully, Pittsburgh; W. H. Markle, Greensburg, Pa.; W. H. Koontz, Somerset, Pa.; John King, Jr., Mendes Cohen, Hugh Sisson, Charles Webb, John D. Smith, Baltimore. The board re-elected John King, Jr., President; J. B. Washington, Secretary; C. Donnelly, Treasurer. The road is leased to the Baltimore & Ohio.

Providence & Springfield.—At the annual meeting in Providence, R. I., Dec. 3, the following directors were chosen: Sidney Dillon, James O. Inman, Horace A. Kimball, J. D. Nichols, John L. Ross, Albert L. Sayles, Wm. Tinkham.

Pullman Palace Car Company.—Mr. John N. McCoy has been appointed Assistant Superintendent at Louisville, in place of C. W. Hall, resigned. Mr. Charles H. Walker succeeds Mr. McCoy as Assistant Superintendent at Cincinnati.

Quincy, Missouri & Pacific.—Mr. Amos Green, General Manager, will act as General Superintendent also, in place of J. R. Buchanan, resigned.

Rochester & State Line.—At the annual meeting in Rochester, N. Y., Nov. 30, the following directors were chosen: Oliver Allen, Donald McNaughton, D. D. S. Brown, Thomas Brown, Jr., Augustus Frank, William Bristol, A. D. Scott, J. S. Waterman, George E. Mumford, Edward Harris, M. F. Reynolds, Thomas Leighton, Gilman H. Perkins. The board elected Oliver Allen President; D. D. S. Brown, Vice-President; D. McNaughton, Secretary and Treasurer; Edward Harris, Attorney.

Shepaug.—At the annual meeting in Litchfield, Conn., recently, the following directors were chosen: Henry W. Buell, Henry W. Coit, Wm. Deming, A. H. Morse, H. O. Morse, Dorsey Neville, Origen S. Seymour, L. W. Wessells, E. M. Wooster. The board re-elected Henry W. Buell, President; Henry W. Coit, Vice-President and Treasurer; Wm. Deming, Secretary.

St. Johns & Indian River.—The officers of this company are: E. Hopkins, President; T. W. Land, Secretary; S. J. Fox, Treasurer; W. H. Churchill, Superintendent, General Freight and Passenger Agent. Offices at Titusville, Volusia County, Florida.

Toledo, Ann Arbor & Northern.—This company has been organized by the election of the following directors: H. W. Ashley, James M. Ashley, James M. Ashley, Jr., Toledo, O.; J. A. Stowell, Dundee, Mich.; J. T. Jacobs, Ann Arbor, Mich. The board elected James M. Ashley, President; A. W. Hamilton, Secretary.

Troy & Boston.—Mr. George A. Sanderson is appointed Through Freight and Passenger Agent for this road and the Bennington & Rutland.

PERSONAL.

—Mr. Samuel Thorne has resigned his position as President of the Newburg, Dutchess & Connecticut Railroad Company.

—Mr. J. H. Morley has resigned his position as Chief Engineer of the Little Rock, Mississippi River & Texas Railroad.

—Mr. D. A. Baldwin, President of the North Wisconsin, and formerly President of the West Wisconsin Railroad Company, was found on Dec. 2 hanging in a barn at New Durham, N. J., having evidently committed suicide. Mr. Baldwin built the West Wisconsin road and formerly held most of the stock, but sold it some time ago to parties connected with the Chicago & Northwestern. He also owned the North Wisconsin, which he was building to secure the land grant. He was at one time connected with the old St. Croix & Superior Company. He owned large flouring mills at Hudson, Wis., and was at one time a very rich man, but it has been understood lately that he was in embarrassed circumstances. For some years he has resided chiefly in New York.

TRAFFIC AND EARNINGS.

Railroad Earnings.

Earnings for various periods are reported as follows:

	1876-77.	1875-76.	Inc. or Dec.	P. c.
Year ending Sept. 30:				
Richmond, Fredericksburg & Potomac	$323,013	$367,970	Dec. $44,957	12.2
Expenses	176,805	185,984	Dec. 9,179	4.9
Net earnings	$146,208	$181,986	Dec. $35,778	19.7
Earnings per mile	3,892	4,433	Dec. 541	12.2
Per cent. of expenses	54.74	50.54	Inc. 4.20	8.3
Ten months ending Oct. 31:	1877.	1876.		
Atchison, Topeka & Santa Fe	$2,097,250	$2,056,343	Inc. $40,907	2.0
Net earnings	1,048,640	1,074,526	Inc. 25,886	2.4
Per cent of expenses	50.00	47.74	Inc. 2.26	4.7
Kansas Pacific	2,663,310	2,500,181	Inc. 163,129	6.5
Net earnings	1,112,495	1,054,825	Inc. 57,670	5.5
Per cent of expenses	58.24	57.81	Inc. 0.43	0.7
St. Joseph & Western	395,676	360,721	Inc. 34,955	9.7
Six months ending Nov. 30:				
Chicago & Northwestern	$7,816,560	$7,649,896	Inc. $166,664	2.2
Net earnings	3,889,558	3,380,531	Inc. 509,027	15.1
Per cent of expenses	50.24	55.81	Dec. 5 57	10 0
Month of September:				
Houston & Texas Central	$297,139	$320,256	Dec. $83,117	25.9
Net earnings	109,422	174,688	Dec. 65,266	37.4
Per cent. of expenses	56.90	45.49	Inc 8.41	18.5
Month of October:				
Chicago & Northwestern	$1,598,775	$1,542,050	Inc. $56,725	3.7
Net earnings	917,303	872,975	Inc. 44,328	5.1
Per cent. of expenses	42 62	43.39	Dec. 0.77	1.8
Detroit & Milwaukee	163,270	.....	.....	....
Net earnings	21,544	.....	.....	....
Per cent. of expenses	86 79	.....	.....	....
Houston & Texas Central	361,650	377,340	Dec. $15,690	4.2
Net earnings	211,995	201,114	Inc. 10,871	5.4
Per cent. of expenses	41.38	46.71	Dec. 5.33	11.4
St. Paul & Sioux City	81,686	68,130	Inc. 13,556	19.9
Sioux City & St. Paul	59,064	47,832	Inc. 11,232	23.5
Third week in November:				
Atchison, Topeka & Santa Fe	$97,186	$56,817	Inc. $40,369	71.1
Denver & Rio Grande	19,536	.....	.....	....
St. Louis, Iron Mt. & Southern	126,600	127,055	Dec. 455	0.4
Week ending Nov. 24:				
Grand Trunk	$201,244	$180,963	Inc. $20,281	11.2

Passenger Rates from the West to Europe.

The agreement given below was adopted at a meeting held Nov. 24 in Chicago, at which the passenger departments of the Lake Shore & Michigan Southern Railway Co., Pennsylvania Railroad Co., Michigan Central Railroad Co., Baltimore & Ohio Railroad Co., and Pittsburg, Cincinnati & St. Louis Railway Co., were represented.

"*First*—From Dec. 1, 1877, the rates between Chicago and foreign points shall be uniform via Philadelphia, Baltimore, New York and Boston.

"*Second*—No tickets of any kind shall be furnished to the agents of the several steamship lines, but they shall issue an order for the railroad ticket upon our several depot ticket agents and such order shall not be accepted unless the same bears the signature or fac-simile of the authorized general agent of the steamship line and countersigned by the agent selling the same. No railroad ticket shall be issued upon such order except a steamship ticket is presented therewith, such order shall be presented for redemption at the end of each month to the said steamship companies, and a commission of one dollar and fifty cents ($1 50) will be allowed to the said general agent of the steamship line.

"*Third*—We will prepare special steamship tickets—first and second-class, regular and limited—which shall be used only in connection with the steamship orders. If any tickets so issued are found upon the market for sale we will redeem the same from the party presenting them by paying full tariff rates and deduct the commission in settlement with the general agent who issued the order.

"*Fourth*—That we will at once take steps to redeem all second-class tickets that may now be on the market of our own issue by paying if necessary full tariff rates for them.

"*Fifth*—On and after Nov. 26 there shall be no commissions whatever paid in Chicago except as provided for steamship agents and further provided that the Grand Trunk Railway and the Erie & Chicago Line may each pay a commission of fifty cents upon such tickets as may be sold over their respective lines. This commission shall not be allowed except upon sales made at the Grand Trunk Railway office at Tremont House, and the Erie & Chicago Line office, corner Clark and Washington streets.

"*Sixth*—That for theatrical parties numbering ten or more a special rate of 75 per cent. of the first-class tariff rate to apply to regularly organized theatrical parties and one ticket only shall be issued covering the entire party."

Buffalo Canal Traffic.

The report for the season down to the end of November (which includes substantially all the business of the year) shows the following:

	1877.	1876.	Inc. or Dec.	P. c.
No of boats cleared	6,908	4,850	Inc. 2,058	42 4
Amount of tolls collected	$467,797	$583,570	Dec. $115,773	19.8
Grain shipped, bushels	48,425,968	27,604,338	Inc. 20,821,630	43.0
Lumber shipped, feet	79,782,688	57,213,501	Inc. 22,569,187	39.6
Pork and lard, tons	8,462	40	Inc. 8,422	....

The provision shipments amounted to an average of four carloads daily during the season of navigation, and would have brought the trunk railroads east of Buffalo about $34,000 of gross earning if they had got them.

British Rail Exports.

The exports of railroad of iron of all kinds for October and the ten months then ending were:

	1877.	1876.	Increase.	P. c.
October	56,048	37,728	18,320	48.6
Ten months	402,096	344,304	57,792	16.8

There were *no* exports to the United States last October, and but 19 tons in October of last year. The total exports to the United States for the ten months were 2,514 tons this year, against 213 last year. The average value of all the exports was £7 3s. 6d. per ton this year in October, £9 2s. 6d. last year, the decrease in average value being thus 21 per cent.

Petroleum Production and Movement.

The production in the oil region and the shipments thence for the months of October and September are reported as follows, in barrels:

	1877.	1876.	Increase.	P. c.
Production	2,484,236	1,589,762	894,474	56.2
Daily product	40,725	26,062	14,663	56.2
Shipments	2,824,768	1,678,739	1,146,029	68.2
Daily shipments	46,307	27,520	18,787	68.2

The distribution of shipments each month was:

	September.				October.			
	1877. Barrels.	P. c. of total.	1876. Barrels.	P. c. of total.	1877. Barrels.	P. c. of total.	1876. Barrels.	P. c. of total.
New York	728,150	46.6	187,389	35.7	512,019	40.3	281,660	24.1
Philadelphia	103,780	6.6	18,771	3.6	80,061	6.3	102,560	8.7
Baltimore	7,323	0.5	26,458	5.0	5,948	0.5	25,688	2.2
Boston	47,452	3.0	28,867	5.5	44,739	3.5	20,986	1.8
Cleveland	408,990	26.2	115,157	22.0	419,068	33.1	270,816	23.1
Pittsburgh	230,313	14.7	119,318	22.8	131,324	10.3	260,215	22.1
Down Ohio	.....	.....	10,798	2.1	8,726	0.7	26,192	2.2
Local points	37,789	2.4	17,542	3.3	67,196	5.3	185,290	15.8
Total	1,563,797	100.0	524,300	100.0	1,268,971	100.0	1,172,306	100.0

Grain Movement.

For the week ending Nov. 24 receipts and shipments of grain of all kinds were, in bushels:

	1877.	1876.	Increase.	P. c.
Lake ports' receipts	3,624,676	2,855,645	769,031	27.0
" " shipments	2,717,945	2,679,746	38,199	1.4
Atlantic ports' receipts	5,789,879	4,329,838	1,460,011	33.7

While receipts and shipments at lake ports are less than they have been most of the fall, they are still larger than ever before at this time. The receipts at the sea-board have been exceeded but four times before this year.

Of the lake ports' shipments, 17 per cent. were by rail this year, against 47½ in 1876, 37 in 1875 and 26¾ in 1874.

Of the receipts at Atlantic ports, 77.7 per cent. were at New York, 9.1 at Baltimore, 4.5 at Philadelphia, 3.7 at Boston, 2.3 at Montreal, 2 at New Orleans and 0.7 per cent. at Portland.

Receipts at New York during the month of November were 15,676,658 bushels, 22 per cent. of which was by rail.

Receipts at Buffalo in November were 9,767,356 bushels, 16 per cent. of which was by rail.

Chicago receipts of all grains and Milwaukee receipts of wheat for the month of November were:

	1877.	1876.	Increase.	P. c.
Chicago	7,002,670	5,913,395	1,089,275	16.6
Milwaukee	2,704,283	2,232,473	471,810	21.1

Baltimore grain receipts for November were as follows, flour in barrels and grain in bushels, flour being reduced to wheat in the totals:

	1877.	1876.	Inc. or Dec.	P. c.
Flour	125,604	132,723	Dec. 7,119	5.4
Wheat	716,870	413,819	Inc. 303,051	73.2
Corn	1,100,468	1,544,871	Dec. 444,403	28.8
Other grain	49,534	75,765	Dec. 26,231	34.6
Totals	2,494,892	2,698,070	Dec 203,178	7.5

For the eleven months ending Nov. 30 the receipts were:

	1877.	1876.	Decrease.	P. c.
Flour	1,061,020	1,215,971	154,951	12.7
Grain	25,868,588	27,027,047	1,158,459	4.3
Totals	31,173,688	33,106,902	1,933,214	5.8

The Buffalo *Commercial Advertiser* reports as follows the grain receipts in that city up to Nov. 30, flour in barrels and grain in bushels:

	Flour.		Grain.	
	1877.	1876.	1877.	1876.
By lake	623,973	777,283	60,523,853	44,552,680
By rail	945,100	1,054,700	13,745,840	12,997,000
Totals	1,569,073	1,831,983	74,269,693	57,549,680

The decrease in flour was 262,910 barrels, or 14.4 per cent.; the increase in grain, 16,720,013 bushels, or 29.1 per cent. The

rail receipts were 60.2 per cent. of the flour this year, and 18.5 per cent. of the grain. For the same period the shipments eastward of grain received by lake were:

	1877.	1876.	Inc. or Dec.	P. c.
By rail	11,592,960	12,299,727	Dec. 706,767	5.7
By canal	48,631,954	27,773,977	Inc. 20,857,977	75.1
Totals	60,224,914	40,073,704	Inc. 20,151,210	50.3

The rail shipments were 19.25 per cent. of the whole this year, against 3069 per cent. last. The canal opened May 8 in 1877, and May 4in 1876.

Coal Movement.

Coal tonnages are reported as follows for the week ending Nov. 24:

	1877.	1876.	Inc. or Dec.	P. c.
Anthracite	542,629	394,416	Inc. 148,213	37.6
Semi-bituminous	83,311	82,897	Inc. 414	0.5
Bituminous	44,038	44,760	Dec. 722	1.6

The coal passing over the Knoxville & Ohio Railroad in Tennessee for the ten months ending Oct. 31 was: From Caseyville mines, 3,997 tons; from Coal Creek mines, 74,740 tons; total, 78,737 tons.

The Delaware & Hudson Canal is closed for the season. The canal has not yet been interrupted by ice, but the company has ordered all boats to lay up, and is making no more canal shipments.

President Gowen has sent the following letter to Chief Engineer Pleasants, of the Philadelphia & Reading Coal & Iron Company, with reference to the miners' wages:

"I am told that the average price of coal for December will require a reduction of wages of about 31 or 32 per cent. below the basis, but you can pay our men at not less than 30 per cent. under the basis. Our railroad tolls for November were the same as those prevailing in the Summer, when we agreed not to go below 30 per cent. In September and October, when the minimum was 20 per cent., we were getting $1.50 for tolls and freights, as against $1.25 for November, and you can inform the men that during next year for every 25 cents advance in tolls and freight, the minimum of wages will be advanced 10 per cent. In other words, when our freights and tolls are $1.50 the minimum will be 20 per cent. below the basis; when they are $1.75 the minimum will be 10 per cent. below the basis; when we get back to the old rate of $2 the basis will be the minimum. In this way the men can rest assured that hereafter high freights, which we want to get, will be high wages, which they want, and which I should like to see them get."

Norfolk Cotton Business.

The receipts of cotton at Norfolk, Va., for November were 91,694 bales, a decrease of 43,112 bales, or 32 per cent. For the three months of the cotton year from Sept. 1 to Nov. 30 the receipts were, in bales:

	1877.	1876.	Decrease.	P. c.
Atlantic, Mississippi & Ohio R. R.	55,303	99,372	44,059	44.3
Seaboard & Roanoke R. R.	92,331	158,978	66,647	41.9
Canals and otherwise	15,098	20,854	5,756	27.5
Total	162,732	279,204	116,472	41.7

Of the total this year 74,698 bales were consigned to Norfolk and 88,034 bales to points beyond.

THE SCRAP HEAP.

Railroad Manufactures.

The Tennessee Iron & Steel Co. is running its mill at Chattanooga, Tenn., double turn on light iron rails and merchant bar, with orders for some time ahead.

The Pennsylvania Railroad shops at Altoona, in the ten months ending Oct. 31, turned out 10 new passenger and 1,771 freight cars, besides all the repair work. Orders were recently given to build six new postal cars and 374 freight cars. Some of the postal cars are already out.

The National Locomotive Works of W. H. Baily & Co., at Connellsville, Pa., recently shipped some locomotives to the Waynesburg & Washington road. These engines were erroneously credited last week to Porter, Bell & Co. The works also shipped recently a 12-ton narrow-gauge engine to the Painesville, Canton & Bridgeport, and a 16-ton passenger engine to the Bellaire & Southwestern. They are building a 16-ton narrow-gauge engine for the Havana, Rantoul & Eastern, and a 22 ton standard-gauge engine for the Allegheny, Kennerdell & Clintonville road.

The Iron Clad Paint Co., at Cleveland, O., in September shipped ten tons of the brown iron-clad paint to the Galveston, Harrisburg & San Antonio road; in October seven tons of the same were shipped to the Mobile & Ohio, which road has heretofore taken over 40 tons of this paint. The company's paint was used on the Cincinnati Southern bridges over the Ohio and Kentucky rivers, and on the St. Louis Bridge. The company is about to get out five new colors made by mixing the different ores; there will then be eight shades.

The Columbus (O.) Rolling Mill is running steadily on iron rails, chiefly re-rolled rails.

The Pennsylvania Steel Co., at Baldwin, Pa., reports its production for November as follows: "Tons of steel made 7,196 tons, tons of ingots bloomed 8,190, tons of finished rails produced 6,915. The largest days work (two turns) in converting department 359 tons, largest tonnage of ingots bloomed in one day, 441 tons, largest product of rail mill in one day, 354 tons. The above work was accomplished by the regular working force of the mills. The converting department working eleven turns per week, each turn 12 hours. The blooming mill and rail mill, each working eleven turns per week, each turn 11 hours. The average weight of rails during the month was 62 lbs. per yard, the rail mill making seven changes of rolls during the month. The shipments of rails during the month were 7,237 tons."

The Vulcan Iron Works, at Chattanooga, Tenn., have just completed a new building 40 by 120 feet, in which they have a new engine and 12 nail machines.

The works of J. H. Bass, at Fort Wayne, Ind., are making 265 wheels per day.

The Roane Iron Co., at Chattanooga, Tenn., are making iron rails for the Memphis & Charleston road.

The Rogers Locomotive Works, at Paterson, N. J., last week shipped a mogul engine to the Louisville & Nashville road.

The contract for three miles of elevated railroad superstructure reported last week, is for the Gilbert Elevated, not the New York Elevated road. The New York Elevated has not yet let the contracts for the superstructure of its new lines.

The Brooks Locomotive Works, at Dunkirk, N. Y., recently delivered to the New York Elevated Railroad an outside cylinder engine with cylinders 8 by 10 inches, four driving wheels 33 inches diameter and 5 feet spread. The engine weighs 15,500 lbs. loaded and with water in the tanks and in the boiler. The tanks hold 100 gallons of water. This is the first outside-connected engine on the road, and is in some measure an experiment.

The Springfield Iron Co., at Springfield, Ill., turned out 3,124 tons of re-rolled iron rails in October.

The car stove works of Mr. Gardner Chilson, at Mansfield, Mass., which were temporarily closed on account of his death, have resumed work, the trustees of the estate taking the management.

The Puget Sound Foundry at Seattle, Wash. Ter., is making 12 car wheels a day for the Seattle & Walla Walla road.

Mullin & Maloney, proprietors of the Eagle Rolling Mill at Pittsburgh, have filed a petition in bankruptcy. Nearly all the claims against them are secured by mortgage, or are preferred claims for wages.

Stamping Boiler Plate.

A Washington dispatch dated Nov. 28 says: "A circular from the office of the Supervising Inspector-General informs supervising and local inspectors of steam vessels that that office has become aware that some manufacturers of boiler-iron are stamping iron of their manufacture at much higher tensile strain than such iron will bear when tested by the Riehle testing-machine, as provided in Rule 4 of the Revised Rules and Regulations for 1877. In consequence of this practice, injury has resulted to boiler manufacturers who innocently purchased such iron and failed to apply the test until after the completion of the boilers, as recently occurred in two cases in the local districts of New York and Philadelphia. To prevent a practice so unjust and manifestly dangerous, Inspectors are directed to obtain samples from plates of all boilers about to be constructed in their districts, and subject them to an actual test before the boilers are begun, and to represent to the boiler manufacturers the importance to themselves of this precaution. Whenever results of such tests fall below the tensile strength stamped on the iron, Inspectors must report such results at once to this office, in a statement according strictly with the formula prescribed in Rule 4, page 18, Revised Rules and Regulations. Inspectors are also directed to carefully ascertain that all samples of boiler-plates tested by them have the homogeneousness and toughness required by section 4,430 Revised Statues, and to be especially careful in that respect where the plates are stamped above 50,000 pounds tensile strength."

OLD AND NEW ROADS.

African Transcontinental.

A petition has been presented to Congress for an appropriation of $50,000, to be used in making preliminary surveys for a railroad from Liberia, on the west coast of Africa, across the continent to some point in the Soudan or on the Upper Nile, a distance of 2,000 miles or thereabouts.

Atlantic, Mississippi & Ohio.

It is stated that the plan of reorganization proposed by the English committee provides for the sale of the road and its purchase by the committee. A new company will be formed, which will issue $6,000,000 new 6 per cent. gold bonds, running 30 years, for funding the divisional securities. The principal of the consolidated 7 per cent. gold bonds will be represented by reorganization second mortgage 5 per cent. gold bonds, having 50 years to run, but these bonds will bear only 4 per cent. for the first five years. Bonds bearing 4 per cent. interest, currency, will be delivered at par for the overdue interest on the consolidated 7 per cent. gold bonds to April 1, 1879, and for the difference between the interest secured by these bonds and that secured by the reorganization second mortgage gold bonds, capitalized from April 1, 1879, to October 1, 1901. The claim of the State of Virginia for $4,000,000 may be represented by reorganization second income 6 per cent. bonds at par, which shall be subordinate in all respects to the 4 per cent. bonds above mentioned.

In the matter of the petition of the Receivers and the trustees under the consolidated mortgage for leave to extend the time of payment of such of the divisional bonds as are now due or will shortly become due, and to attach to such bonds as are extended certificates having the necessary numbers of coupons, the United States Circuit Court has decided to grant the petition and to direct the necessary order to be entered. The Court holds that, while the trustees under the divisional mortgages did right in entering formal objections, yet there can be no serious arguments against the order. The matter rests entirely with the bondholders and, if they are willing to extend the time of payment of the principal of their bonds, there can be no serious objection from other parties. In giving this decision the Court referred at some length to the advantages secured by the consolidation of the road and the loss that would result from the breaking up which would follow separate foreclosures of the divisional mortgages.

The bonds which it is proposed to extend are $157,000 Norfolk & Petersburg first-mortgage, due in 1868 and extended to 1875; $306,000 Norfolk & Petersburg first-mortgage due in 1868 and extended till 1877; $5,000 Virginia & Tennessee first-mortgage, due since 1872; $267,500 Virginia & Tennessee interest funding bonds, and $131,444 bonds issued by the consolidated company in 1873 to fund certain coupons on the divisional bonds, these funded coupons falling due in January, 1879. The whole amount is $866,944, and it is stated that most of the bondholders have agreed to the proposed extension.

Atchison, Topeka & Santa Fe.

The Treasurer's report for October and the ten months ending Oct. 31 is as follows:

	October, 786 miles.	Ten months, 729 miles.
Freight earnings	$254,738 56	$1,416,516 00
Passengers	81,093 97	609,373 03
Express, mail and miscellaneous	6,989 95	71,360 61
Total	$342,822 48	$2,097,249 64
Operating expenses	129,640 05	1,048,609 44
Net earnings	$213,182 43	$1,048,640 20
Per cent. of expenses	37.82	50.00

As compared with 1876, October shows an increase of $44,-864.72, or 15.1 per cent., in gross, and of $34,304.96, or 19.2 per cent., in net earnings; the ten months show an increase of $40,906.84, or 2 per cent., in gross earnings, and a decrease of $25,885.42, or 2.4 per cent., in net earnings. The mileage worked in 1876 was 711 miles in October and an average of 694 miles for the ten months.

Bellaire & Southwestern.

A correspondent writes: "Tracklaying was begun on the Bellaire & Southwestern Railroad Nov. 23. This is a proposed narrow-guage line between Athens, in Athens County, O., and Bellaire, by way of Beallsville. Forty miles of the line are graded. The company will lay 10 miles of track this fall and the balance in the spring."

Brunswick & Albany.

It is again reported that a contract has been concluded for the sale of this road to H. G. Wheeler and others, of London, for $1,000,000. It is said that Mr. Wheeler has gone to England to complete arrangements for the immediate construction of the extension from Albany, Ga., to Eufaula, Ala., upon which some work was done several years ago.

Baltimore & Ohio.

The Virginia Court of Appeals has just decided that this company is liable for damages for the persons killed by the giving way of the Narrow Passage bridge on the Valley Branch, about two years ago. The bridge was on a part of the road leased by the Baltimore & Ohio, but owned by the Virginia Midland Company.

Buffalo & Jamestown.

The New York Supreme Court having confirmed the sale of this road, the bondholders who bought it met in Buffalo, N. Y., Dec. 3, and organized a new company. They named the new corporation the Buffalo & Southwestern Railroad Company.

Cairo & St. Louis.

A dispatch from Springfield, Ill., Nov. 27, says: "In the case of Taylor vs. the Cairo & St. Louis Railway Company pending in the United States Court, Hon. S. C. Judd, attorney for the railroad, to-day applied for a modification of the proceedings. It appears that the original line by which the company entered the City of Cairo has been washed away by the river, and that the company sought to enter by another line which has also been washed away. Pending proceedings as to the condemnation of this last line the company had deposited $5,000 in the United States Court here to secure the payment of damages. To-day this deposit was withdrawn by order of the court, and the company will institute proceedings in the State Court for the condemnation of another route, which will, it is expected, be safe from the encroachments of the river."

Cayuga.

This road, which was lately sold under foreclosure of the first mortgage, will be hereafter known as the Cayuga Southern, and will be operated for account of the purchasers and by their agent. It is controlled by the Lehigh Valley, and extends from Ithaca, N. Y., on the Geneva, Ithaca & Sayre road (owned by that company) north to Cayuga, 38 miles.

Chicago, Burlington & Quincy.

It is said that this company has finally concluded an agreement with the Chicago & Northwestern for the use of the bridge over the Mississippi at Clinton, and that the necessary connecting tracks have been put in. This will give the company a direct connection, over its Mendota & Clinton Branch, with the river roads from Clinton to La Crosse. The Northwestern has always heretofore refused to make any agreement for the use of its bridge. It does not follow, necessarily, that the business of the river roads will all be done over the Chicago, Burlington & Quincy.

Chicago, Milwaukee & St. Paul.

The Necedah Branch of this road is now completed and opened for traffic. It extends from the La Crosse Division at Lisbon, Wis., northward to Necedah in Juneau County, and is 12 miles long.

Chicago, St. Louis & New Orleans.

At a meeting of the stockholders in New York, Nov. 28, the agreement for the consolidation of the New Orleans, Jackson & Northern and the Central Mississippi Railroad companies under the above name was formally ratified and completed. The companies consolidated were formed recently by the bondholders who bought the New Orleans, Jackson & Great Northern and the Mississippi Central roads at foreclosure sale. The two roads, it will be remembered, were consolidated several years ago under the name of New Orleans, St. Louis & Chicago, but the consolidation was broken up by the subsequent foreclosure of the separate mortgages. The consolidated company owns a line 548 miles long, from New Orleans northward to Fillmore, Ky., opposite Cairo, with a branch from Durant, Miss., to Kosciusko, 21 miles long. A controlling interest in the company is owned by the Illinois Central, and the line will be worked in the interest of that company, as it has been for some time past.

It is announced that the debt of the old Mississippi Central to the State of Tennessee has been paid by the transfer to the State Treasurer of about $1,200,000 in State bonds and overdue coupons thereon.

Chicago & Northwestern.

At a meeting of the board, held in New York, Dec. 3, the following statement was submitted, November earnings being partly estimated, for the six months ending Nov. 30:

Gross earnings		$7,816,560 17
Expenses and taxes (50.24 per cent.)		3,927,000 08
Net earnings		$3,889,560 09
Interest on bonds and gold premium	$1,633,565 17	
Rentals of leased lines	648,491 28	
		2,282,056 45
Surplus over fixed charges		$1,557,503 64
Sinking funds	$108,120	
Dividend of 3½ per cent. on $21,522,400 preferred stock	753,284	
		861,404 00
Surplus		$696,099 64

On this showing it was resolved to declare a dividend of 3½ per cent. on the preferred stock. The statement includes the earnings and expenses of the proprietary roads.

Corning, Cowanesque & Antrim.

The gauge of this road between Lawrenceville, Pa., and Antrim, 37 miles, was changed from 6ft. to 4ft. 8½ in. on Saturday, Dec. 1. The company has already a third rail on the 15 miles from Lawrenceville to Corning, N. Y., which gives it a road of standard gauge from the mines at Antrim to Corning, and, in connection with the Syracuse, Geneva & Corning, to Geneva, N. Y., on the New York Central.

Danville, Hazleton & Wilkesbarre.

In the Court of Common Pleas at Bloomsburg, Pa., Dec. 2, argument was heard in the suit begun to foreclose the first mortgage on this road. The foreclosure was opposed by the company and Simon P. Kase. The Court reserved its decision.

Dividends.

Dividends have been declared as follows:

Boston & Lowell, 2 per cent., payable Jan. 1. This is the first dividend since January 1875.

Chicago & Northwestern, 3½ per cent. on the preferred stock, payable Dec. 27.

Eastern.

The President of this company has issued the following notice to holders of Portsmouth, Great Falls & Conway bonds:

"The directors of the Eastern Railroad Company are advised that the special statute and mortgage under which they are now acting in effect prohibits their paying interest on the Conway bonds. To settle the question finally, suit has been brought in the Supreme Judicial Court, which will be pushed to the speediest possible conclusion, and will be decided, it is believed, within three months. Meanwhile, as security for the bondholders, the directors have set aside a fund equal to the interest accruing Dec. 1, which is approp iated solely to paying that interest should the Court decide in favor of the right of the company to pay it."

Accordingly the December coupons on the Conway bonds were not paid.

East River Bridge.

At a meeting held in Brooklyn, N. Y., Dec. 3, the trustees awarded a contract for parapet stone for the approaches to the Concord Granite Company, the amount of the bid being $49,754. A contract for Bessemer steel wire was let to John A. Roebling's Sons at 7 cents a pound.

Erie.

Counsel for James McHenry have filed in Pike County, Pa., a complaint in a suit intended to be concurrent with those already begun in New York and New Jersey. The complaint is similar to those filed in the other suits.

Attorney-General Fairchild, of New York, has been hearing arguments on the question whether the accounts of Hugh J. Jewett as Receiver, as passed and adopted in the foreclosure suit of the Farmers' Loan & Trust Company, shall be adopted as final in the original suit begun by the Attorney General, in which Mr. Jewett was first appointed Receiver. Argument was closed Dec. 4, but no decision announced.

Foreclosure Sales.

The *Selma & Gulf* road was offered for sale at Selma, Ala., Nov. 19, under a decree of foreclosure granted by the Alabama Chancery Court. No bids were offered and the sale was adjourned.

Future sales are noted as follows:

The *Springfield & Northwestern* road will be sold in Springfield, Ill., Dec. 28, under a decree of foreclosure granted by the United States Circuit Court. The road is completed from Springfield to Havana, 47 miles.

The *Maryland & Delaware* road will be sold at Easton, Md., Dec. 20, by James B. Groome, trustee, under foreclosure of the first mortgage. The 15 miles in Delaware will be sold under a decree granted by the United States Circuit Court, the rest of the road in Maryland under a decree of the Talbot County (Md.) Circuit Court. The terms of sale are, one-half the purchase money payable at the time of sale, the rest upon confirmation of the sale; bonds will be received as cash at their *pro rata* value for the amount in excess of the costs of the suit. The road extends from Clayton, Del., southwest to Oxford, Md., 52 miles, and is controlled by parties interested in the New Jersey Southern.

Fond du Lac, Amboy & Peoria.

This road is now completed and trains are running to Iron Ridge, Wis., 30 miles south from Fond du Lac. At Iron Ridge connection is made with the Chicago, Milwaukee & St. Paul.

Golden, Boulder & Caribou.

This company has filed articles of incorporation to build a railroad from Golden, Col., to Caribou. The capital stock is to be $50,000. The road will be a short line, chiefly intended to haul coal from the Caribou mines.

Illinois & St. Louis Bridge.

The trustees under the first mortgage give notice that on Nov. 30 they drew for the sinking fund, in accordance with the provisions of the mortgage, 72 of the bonds, the numbers of which are: 58, 80, 136, 170, 177, 227, 247, 313, 635, 686, 723, 804, 813, 853, 868, 914, 922, 1132, 1140, 1162, 1185, 1451, 1462, 1481, 1530, 1546, 1803, 1813, 1847, 1884, 1912, 1995, 2074, 2076, 2085, 2101, 2102, 2192, 2218, 2221, 2337, 2472, 2684, 2710, 2770, 2778, 2875, 2883, 2887, 2907, 2911, 3034, 3036, 3048, 3116, 3144, 3209, 3227, 3282, 3335, 3380, 3496, 3502, 3569, 3571, 3587, 3606, 3712, 3724, 3760, 3806, 3992.

Kansas Pacific.

The Receivers have given notice to bondholders as follows: "By authority of the Circuit Court of the United States for the District of Kansas, the undersigned are empowered to distribute to each of the several classes of first mortgage bonds of the Kansas Pacific Railway Company below described, that have heretofore not funded their coupons under the funding arrangement of January, 1874, an amount equal to the interest money received by the bonds that entered into the funding arrangement, including an allowance of 6 per cent. per annum from the time when similar payments were made to the bondholders last mentioned.

"The bonds on which this equalization of interest payments will be made are of the following classes, viz.:

"First mortgage bonds, interest payable February and August.

"First mortgage bonds, interest payable June and December.

"First mortgage bonds, interest payable May and November (Denver Extension).

"Accordingly, the National Bank of Commerce of the City of New-York will, on and after the 1st of December, 1877, pay for our account to the holders of unfunded bonds the amount set forth in the explanatory circular, to be had at the bank. Holders of bonds belonging to the several classes above mentioned will be required to present the coupons which matured from Nov. 1, 1873, to Nov. 1, 1876, both inclusive, in exchange for the certificates of indebtedness in accordance with the funding arrangement of 1874."

Lake Shore & Michigan Southern.

The Cleveland *Herald* of Dec. 1 says: "On Sunday morning last one track was laid across the new Lake Shore railroad bridge over Ashtabula Creek. The work of laying 600 feet of rails and making the connections was done in one hour. On Wednesday the other track was laid, and Thursday the trains were running upon it. During the construction of the new bridge the old trestle work with a single track across it has been used. This is the one that was placed there after the old bridge broke down near a year ago. The new bridge, constructed by the Keystone Bridge Company, of Pittsburgh, was made after plans by the best engineers in the country, and it is doubtless one of the best bridges ever erected."

Long Island.

It is reported that a considerable part of the leased Flushing, North Shore & Central road is to be abandoned and the track taken up. The line to be given up is that originally known as the Central Railroad of Long Island and the Central Extension, running from Flushing diagonally across the island to Babylon. The arrangement proposed is to retain the short section from the crossing of the Long Island main line to Garden City and to build a short branch from Queens to Creedmoor, and then take up the track from Flushing to the Long Island crossing and from Garden City to Babylon. The local traffic could doubtless be nearly as well served under this arrangement, but the holders of Central and Central Extension bonds may object to the abandonment of their line.

Notice is given that the Long Island Railroad Company will pay the coupons on the Smithtown & Port Jefferson bonds, which became due Sept. 1, but were not then paid, on presentation at the company's office in Long Island City, or at the office of Drexel, Morgan & Co., New York.

Meetings.

Meetings will be held as follows:

Cleveland & Pittsburgh, annual meeting, at the office in Cleveland, O., Jan. 2. Transfer books were closed Dec. 3.

New York, Providence & Boston, annual meeting, at the office in Providence, R. I., Dec. 12, at 10 a. m.

Michigan Air Line.

Local papers state that this road has been sold to General Manager Hickson, of the Grand Trunk, and that preparations are being made to extend it. It is now in operation from Ridgeway, Mich., to Romeo, 16 miles.

Mobile & Ohio.

A circular issued by the Reorganization Committee says that there have been deposited with the committee $7,035,540 of the first-mortgage bonds, or 88.8 per cent., of the whole amount; $1,588,000, or 95.2 per cent., of the Tennessee substitution bonds; $1,052,439, or 72.4 per cent., of the second-mortgage bonds; $480,525, or 89.9 per cent., of the convertible bonds, in all $10,156,504, or 87.7 per cent., of all the bonds. The circular further says that the parties who have taken the appeal to the United States Supreme Court hold only about 2 per cent. of the bonded debt. The execution of the committee's plan is delayed for the present by this appeal.

Montour Branch.

A company has been organized to build a railroad from a point eight miles from Pittsburgh, on the new Pittsburgh & Lake Erie road up Montour Run about 10 miles. It is said that the road can be built at small cost and with easy grades. It will serve several coal mines.

New Brunswick.

It is understood that this road is to be extended next season to Edmunston, N. B., 38 miles beyond the present terminus at Grand Falls. The terminus will then be about 10 miles from the Quebec Province line and 70 miles from Riviere du Loup. It has always been the intention of the company to build through to Riviere du Loup, but, in order to hasten the completion of the road the Quebec papers are advocating the formation of a company to build the 60 miles from Riviere du Loup to the Province line. The route is by Lake Temiscouata and the Madawaska River; the country is for the most part fertile and there is some timber on the line. There is a considerable population about Lake Temiscouata, and the Madawaska settlements are among the oldest in Canada.

New Jersey Southern.

General Manager W. S. Sneden has submitted to the trustee the following statement for the three years and nine months from Jan. 1, 1874, to Sept. 30, 1877.

Gross earnings		$1,809,748 94
Old accounts, etc		7,587 48
Total		$1,817,336 42
Working expenses	$1,415,173 93	
Construction, equipment, etc	173,521 57	
Expenses of foreclosure	114,801 18	
		1,703,495 68
Balance		$113,840 74

The floating assets and liabilities Sept. 30 were as follows:

Cash balance	$124,729 56
Agents' balances, accounts due, etc	28,158 84
Total assets	$152,888 40
Liabilities for wages, supplies, connecting lines, etc	39,047 66
Surplus of assets	$113,840 74

For the year 1877 the returns for nine months, with approximate estimates for the remaining three months show a falling off of total earnings compared with last year of about $58,500. The operating expenses were reduced over $43,500. The net revenue was about $58,000, or $15,000 less than last year. The freight revenues increased somewhat over last year, but the passenger earnings decreased more than was expected.

There was an increase of passengers carried between New York and Long Branch and other points on the sea shore branch but a very large decrease in the Philadelphia travel both from New York and Long Branch. The large amount of travel between New York and Philadelphia last year was due to the Centennial business, but comparing the present year with 1875 the decrease is accounted for by the rivalry of the Bound Brook Line, causing the fares to be cut down on the New Jersey Division of the Pennsylvania Railroad, so that it left no inducement for travelers to seek the Southern road. The Philadelphia business was also damaged by the turning of travel by the Pennsylvania road via Freehold and Squan and its connection with the New Jersey Central line.

New Jersey Railroad Taxation.

In the case of the Morris & Essex Railroad Company against Yard, State Commissioner of Railroad Taxation, the United States Supreme Court has refused the motion for a rehearing. The decision of the Court, reversing that of the New Jersey courts and holding the company liable to taxation only as provided by its charter, will therefore stand as final in the case. The mandate of the Supreme Court was last week formally presented to the New Jersey Court of Errors and Appeals.

Ohio Canals.

The lessees of the Ohio State canals formally surrendered them to the State Nov. 30. The Board of Public Works, however, has declined to receive them, partly because it is doubtful whether the condition of the canals is as good as when the lessees took possession. The lessees claim that they have lost money by their contract, the Miami Canal being the only one upon which there was not an actual loss.

Oregon Central.

A bill has been introduced in Congress to extend for three years the time for the completion of this road from Portland, Oregon, to Astoria, on condition that the company begins work on this line at once, completes 50 miles in one year and the whole road in three years. Should it fail to comply with these conditions, the bill provides that the land grant may be transferred to any company which will build the road.

Paw Paw.

The gauge of this road was changed from 4 ft. 8½ in. to 3 ft. on Nov. 25. The object of the change is to conform the gauge to that of the Toledo & South Haven road, of which the Paw Paw road is to become a part, and of which a section has been finished, from Paw Paw to Lawrence. The road is four miles long, from Paw Paw, Mich., to Lawton on the Michigan Central. Some of the stockholders objected to the change of gauge and procured an injunction, which, however, failed to prevent the change, owing to a technical omission. Further legal proceedings are to be taken.

Port Dover & Lake Huron.

At a meeting of the creditors, held recently in Woodstock, Ont., it was resolved not to press claims against the company until after the annual meeting in February next. It was also resolved that the creditors meet at the same time with the stockholders, with a view to making such arrangements as may then appear best.

Seaboard & Roanoke.

A contract has been let for a temporary wooden bridge over the Roanoke at Weldon, N. C., to replace the one recently carried away, and work is being pushed as fast as possible. The company intends to put up a substantial iron bridge on stone piers, so that the bridge now erected will only be for temporary use.

Southeastern, of Canada.

The St. Albans (Vt.) *Messenger* says: "The Passumpsic have now brought a bill for the foreclosure of their mortgage on the Missisquoi & Clyde Rivers road.

"The present situation, therefore, seems to be that the Passumpsic will continue, if it please, to operate the road from Newport to North Troy; that the Southeastern will run the Canada portion, in fragments; that suits by the Passumpsic are pending against the Southeastern in both Canada and Vermont, which are not likely to reach trial for some time; that meanwhile the Central Vermont is happy, because the Passumpsic's through line between Boston and Montreal is interrupted; and the probabilities are that by and by some wise conciliator will step in and help the parties to an honorable settlement of their financial differences and to some new arrangement for running in connection, since this will be for the obvious advantage of both roads and for the public interest."

South Mountain.

Local papers report that work has been resumed with a small force near Jonestown, Pa., and that ties are being delivered along the road. It is said that track is to be laid on the five miles between Jonestown and Fredericksburg, to accommodate some local business.

Springfield, Athol & Northeastern.

The Springfield *Republican* says: "It is understood that negotiations are in progress between Willis Phelps and Chester W. Chapin for the transfer to the latter of a large quantity of Athol Railroad bonds, stated to be more than $100,000, and surmised to be enough to give him the control of the road."

St. Louis, Lawrence & Western.

The whole of the Eastern Division of this line, from Lawrence, Kan., to Pleasant Hill, Mo., is now operated by the Atchison, Topeka and Santa Fe. The 17 miles from De Soto Junction to Lawrence forms part of the Kansas City line, as it has done since the opening of that line; the 44 miles from De Soto Junction to Pleasant Hill is worked as a branch and called the Pleasant Hill Division.

The Elevated Railroads in New York.

Work in laying the foundations for the Gilbert and New York Elevated roads has been carried forward very rapidly within the last few weeks. The foundations and bed castings for the Gilbert road are laid on West Broadway from Chambers street to Canal, and on South Fifth avenue from Canal to Amity street. For a distance of several blocks on South Fifth avenue, and also on Amity or Third street, the superstructure was erected about a year ago. On Sixth avenue the foundations are nearly all laid from Amity to Forty-second street, excepting at some of the cross streets, where unexpected difficulties, such as water or gas pipes, or sewers, were encountered. On West Broadway a few of the columns have been erected, and the contractors have also commenced erecting at Forty-second street.

The New York Elevated Company has the foundations laid for its second track nearly all the way from the Battery along the Greenwich street line up Ninth avenue to Sixtieth street. The same company has also laid many foundations on Pearl and on Chatham streets for its east-side line. The contracts for the superstructure, however, still hang fire, although it is expected that they will soon be given out. The difficulty in the way of letting them has not been explained.

Toronto, Grey & Bruce.

This company desires to change its gauge from 3 ft. 6 in. to the standard 4 ft. 8½ in. The estimated cost of the change, involving an entire new equipment, and a large quantity of new rails, is $900,000, and it is proposed to raise $300,000 by a loan from the Dominion Government and $600,000 by municipal bonuses or loans, the company's bonds to be issued in exchange. The company owns 195 miles of road, a main line 122 miles long from Toronto, Ont., to Owen Sound, and a branch line 73 miles long, from Orangeville to Teeswater. The estimated expense of the change is over $4,500 per mile, which seems pretty high.

Wabash.

The Fort Wayne (Ind.) *Sentinel* is informed by officers of this company that it has been decided to remove the repair shops from Fort Wayne to the property owned by the company near Antioch, Ind. The reasons given are that additional room can be had there, which cannot be secured in Fort Wayne without incurring heavy expense, and that the new location would be more convenient for a division station.

Wilcox County.

It is proposed to build a railroad from Camden, in Wilcox County, Ala., eastward to a connection with the Selma & Gulf road. The distance is about 18 miles, and it is thought that the road can be very cheaply built.

Ripley.

This road has been in operation for several years from the Memphis & Charleston at Middleton, Tenn., south to Ripley, Miss., 25 miles. The control of the road and nearly all its debt have lately passed into the hands of some citizens of Ripley, who have put the road in good order, and purpose extending it southward through Pontotoc and Chickasaw counties.

Worcester & Somerset.

It is reported that this road is to be extended from Newtown, Md., southeast to Chincoteague Sound at the mouth of the Swansgut, a distance of 12 miles, and also that a further extension will be built down the peninsula to Cherrystone, Va., about 50 miles. The object of these extensions is to take traffic from the Worcester Railroad, and to prevent or anticipate an extension of that road to Cherrystone. It is not likely that any profit could be made from the extensions; the Chincoteague oyster and fish business is barely enough to support one road, while the Eastern Shore below the Virginia line is sparsely peopled and is everywhere accessible by water.

ANNUAL REPORTS.

Connecticut Valley.

This road extends from Hartford, Conn., southeast down the west bank of the Connecticut River to Saybrook Point, 46.5 miles. It is now in possession of the State Treasurer of Connecticut as trustee under the second mortgage and is managed by his agents. The present report is for the year ending Sept. 30, 1877.

The equipment consists of 7 engines; 14 passenger and 7 baggage cars; 69 merchandise and 90 coal, gravel and other cars.

The general balance sheet is as follows:

Stock ($22,989 per mile)		$1,069,000 00
First-mortgage bonds ($21,505 per mile)		1,000,000 00
Second-mortgage bonds ($26,882 per mile)		1,250,000 00
Interest unpaid on second mortgage bonds		437,500 00
Floating debt		280,435 81
Total ($86,816 per mile)		$4,036,935 81
Construction and equipment ($65,901 per mile)	$3,064,388 76	
Land resources	300,382 12	
Profit and loss	654,937 10	
Sundry accounts	17,227 83	
		4,036,935 81

The work done for the year was as follows:

	1876-77.	1875-76.	Inc. or Dec.	P. c.
Train mileage, passenger	76,005	95,293	Dec.. 19,288	20.2
" " freight	60,527	60,225	Inc.. 302	0.5
" " service	34,476	6,557	Inc.. 27,919	425.8
Total	171,008	162,075	Inc.. 8,933	5.5
Passengers carried	206,702	303,762	Dec.. 97,060	31.9
Passenger mileage	3,508,582	4,118,004	Dec.. 609,422	14.8
Tons freight carried	64,844	75,544	Dec.. 10,700	14.2
Tonnage mileage	2,177,381	2,613,175	Dec.. 435,794	16.7
Av. pass. train load, No	46.17	43.21	Inc.. 2.96	6.9
Av. freight train load, tons	35.97	43.39	Dec.. 7.42	17.1

The earnings for the year were as follows:

	1876-77.	1875-76.	Inc. or Dec.	P. c.
Passengers	$86,608 84	$123,111 98	Dec. $36,508 14	29.7
Freight	83,313 81	128,845 27	Dec.. 45,531 46	35.4
Express, mail, etc	11,408 88	16,884 63	Dec.. 5,475 75	32.4
Total	$181,326 53	$268,841 88	Dec.. $87,515 35	32.6
Working expenses	122,806 99	255,149 25	Dec.. 132,842 26	52.1
Net earnings	$59,019 54	$13,692 63	Inc... $45 326 91	330.9
Gross earn. per mile	3,899 50	5,781 04	Dec.. 1,881 54	32.6
Net " "	1,269 24	294 47	Inc... 974 77	330.9
Per cent. of expenses	67.45	94.91	Dec... 27.46	28.9

The management of the Trustee seems to have made a very great reduction in expenses, in spite of adverse circumstances. The great loss in earnings was chiefly due to an absolute loss of business, though there was a considerable reduction in rates.

The income account was as follows:

Net earnings		$59,019 54
Interest	$43,403 40	
Bills payable, old accounts, taxes, etc	25,971 05	
Improvements, equipment, etc	12,160 77	
Conn. Central track rent	4,000 00	
Cash and material on hand	12,728 61	
		98,263 83
Deficit for the year		$39,244 29

It is understood that some negotiations have been in progress for a reorganization of the company, but thus far without result. The second-mortgage bonds, on which no interest has ever been paid, were formerly held by the Charter Oak Life Insurance Company, but are now the property of Mr. Matthews, of New York. The parties who desire to control the road have been negotiating for the purchase of these bonds from Mr. Matthews, but have not been willing to give the price asked.

Only one coupon on the first-mortgage bonds is reported unpaid. Default on these bonds were made Jan. 1, 1877, but one coupon has since been paid.

Boston & Maine.

This company's lines are as follows:

	Miles.
Main Line, Boston to Portland, Me.	115.50
Medford Branch	2.00
Methuen Branch	3.75
Great Falls Branch	2.75
Salmon Falls & South Berwick Branch	2 50
Total owned	126.50
Newburyport R. R., leased	26.98
Danvers R. R., leased	9.26
West Amesbury Branch, leased	4.50
Lowell & Andover, R. R., leased	8.73
Dover & Winnipiseogee R. R., leased	29.00
	78.47
Total owned and leased	204.97

The Methuen Branch is leased to the Manchester & Lawrence road, leaving 201.22 miles worked. The latest report is for the year ending Sept. 30, 1877.

The equipment consists of 77 locomotives, 11 snow-plows, 168 passenger and baggage cars and 1,620 merchandise and other cars.

The balance sheet at the close of the year was as follows:

Stock (received from sale of 70,000 shares, being $54,714 per mile)		$6,921,274 52
Bonds, 7 per cent. ($27,668 per mile)		3,500,000 00
Notes payable, interest and dividends uncalled for		50,560 08
Balances of accounts		17,705 48
Lowell & Andover improvement account		9,976 69
Profit and loss		1,433,148 70
Total ($94,329 per mile)		$11,932,665 47
Construction and equipment ($85,095 per mile)	$10,756,855 97	
Boston & Maine stock	27,000 00	
Interest in leased lines, stocks, bonds and advances	814,585 33	
Notes receivable	5,180 91	
Materials on hand	178,317 39	
Cash	150,715 87	
		11,932,665 47

During the year $99,500 of bonds were sold and the proceeds used to pay off the floating debt. The floating debt was reduced about $120,000, and at the close of the year was only $32,009.08.

The work done was as follows:

	1876–77.	1875–76.	Inc. or Dec.	P. c.
Train miles run.	1,647,759	1,645,632	Inc.. 2,127	0 1
Pass'gers carried.	4,442,019	5,086,819	Dec.. 644,800	12.7
Passenger mileage	61,779,576	67,897,723	Dec.. 6,118,147	9.0
Tons freight carried	698,881	701,945	Dec.. 3,064	0.4
Tonnage mileage.	36,036,193	30,421,902	Inc.. 5,614,291	18.5

The earnings for the year were as follows:

	1876–76.	1875–76.	Inc. or Dec.	P. c.
Passengers	$1,259,361 38	$1,354 202 37	Dec.. $94,840 99	7.0
Freight	836,579 16	842,779 65	Dec.. 6,200 49	0.7
Mails and express	77,262 01	81,475 53	Dec.. 4,213 52	5.2
Rents, etc	62,515 69	49,335 52	Inc.. 13,180 17	26.7
Interest and premium	31,301 19	42,826 46	Dec.. 11,525 27	26.9
Total	$2,267,019 43	$2,370,619 53	Dec.. $103,600 10	4 4
Expenses	1,606,054 97	1,611,166 45	Dec.. 5,111 48	0 3
Net earnings	$660,964 46	$759,453 08	Dec.. $98,488 62	13.0
Gross earnings per mile	11,266 37	11,781 23	Dec.. 514 86	4.4
Net earnings per mile	3,284 79	3,774 24	Dec.. 489 45	13.0
Per cent. of expenses	70.84	67.96	Inc.. 2.88	4.2

Included in expenses, besides taxes, are rentals of leased lines, amounting to $87,200 in each year. Taxes last year were $95,672.35, a decrease of $10,875.45, or 10.2 per cent., from the previous year. The income account for the year was as follows:

Net earnings		$660,964 46
Less interest		245,802 73
Net balance		$415,161 73
Balance Sept. 30, 1876		1,369,449 63
Cash received from accounts charged off as worthless		315 30
Total		$1,784,926 66
Dividends, 5 per cent	$350,000 00	
Old accounts charged off	1,777 96	
		351,777 96
Balance, Sept. 30, 1877		$1,433,148 70

The decrease in earnings is due to falling off in local travel and freight, to low rates on the through business, and to the loss resulting from the engineers' strike. Expenses were increased by large renewals with steel rails, the whole cost of which was charged to expenses.

During the year four locomotives and two smoking and baggage cars were added to the equipment and two locomotives rebuilt. Two new stations were built and two enlarged. The Merrimack River bridge at Haverhill was thoroughly repaired. There were used in renewals 2,060 tons of steel rails; there are now 91.65 miles of track laid with steel.

Referring to the sources of expense, the report says: "A serious element of expense is the alarming increase in State and municipal taxes which railroad corporations have been subjected to within a few years. State and municipal debts have increased so fast that the authorities have become alarmed, and are driven to every expedient to find the means to meet their expenses. As corporations are bodies whose complaint can only be made by proxy, advantage has been taken of them, and a large share of this increased municipal indebtedness has been put upon them, until the taxes on railroads have become a grievous burden. The increase in taxes on the Boston & Maine Railroad has been from $6,000 per annum in 1860 to $106,000 per annum in 1876."

The only serious accident of the year was the collision at Ballard Vale on Nov. 17, 1877. This was caused by a misplaced switch, which had been left open by an old and trusted employe, not, however, from carelessness, but rather from excess of caution, he having left the switch in haste to replace a missing bolt.

The report refers at length to the strike of the locomotive engineers in February last, and is naturally somewhat bitter towards the Brotherhood. It says, in conclusion of its reference to this point:

"The determined stand taken during the struggle by your directors gained you a complete victory, although at considerable cost. * * While we had generally good men to run our engines before the strike, we had no difficulty in well filling their places, and those now in our employ are quite as good as those who left us—yea, better, inasmuch as they are bound to no secret organization, and consequently are free agents.

"Not one of the men who voluntarily left us on the 12th of February is now in our employ; very few of them have been able to obtain any employment since. This is the natural result of labor unions, in whose interest they worked. It is hardly probable that, in the face of this result, another similar conspiracy could be organized in New England."

Galveston, Brazos & Colorado.

This road is completed from Galveston, Tex., westward 15 miles, and negotiations are in progress for its extension westward to Brazoria and the Caney River. The road is of 3 ft. gauge, and the average mileage was 12 miles, 5 miles having been built during the year. Its report is for the year ending Aug. 31, 1877, at the close of which the balance sheet was as follows:

Stock ($1,333 per mile)		$20,000 00
Floating debt ($7,761 per mile)		116,419 08
Income account		19,664 92
Total ($10,406 per mile)		$156,084 00
Construction, equipment and real estate	$149,610 33	
Cash and bills receivable	6,473 67	
		156,084 00

Arrangements have been made to fund a large part of the floating debt in first-mortgage bonds. The work done for the year was:

Passengers carried	21,460
Passenger mileage	188,850
Tons freight carried	142,614
Tonnage mileage	857,641

The average rate per passenger per mile was 2.50 cents; per ton per mile, 3.88 cents. The earnings for the year were:

Passengers	$4,721 26
Freight	33,276 47
Other sources	7,680 81
Total ($3,806.55 per mile)	$45,678 54
Expenses (56.97 per cent.)	26,013 62
Net earnings ($1,633.74 per mile)	$19,664 92

One person was killed during the year, from his own carelessness. Arrangements have been made to begin work soon on the extension of the road.

Union, of Baltimore.

This road is about 7¼ miles long, connecting the Northern Central and Baltimore & Potomac roads with the wharves at Canton and with the Philadelphia, Wilmington & Baltimore road just opposite Baltimore. It is owned by the Canton Company, a land company, and was built chiefly to bring business to that company's property. It was a very costly work, including a tunnel 3,410 feet long and many bridges. The liabilities of the Union Railroad Company are:

Bonded debt ($200,000 per mile)	$1,500,000 00
Due Canton Co., right of way, rents, etc	1,002,783 11
Bills payable and unsettled accounts	58,846 17
Total	$2,551,629 28

The capital stock is all owned by the Canton Company. For the year ending May 31 the number of loaded freight cars passed over the road was: 1876–77, 28,476; 1875–76, 18,568; increase, 9,908, or 53.3 per cent. During the last year 6,745 cars of grain were transferred at the company's elevator. The earnings of the road for the year were:

Passengers	$45,422 80
Freight	61,398 22
Mail and express	1,462 90
Total	$108,283 92
Transportation expenses (28 98 per cent.)	31,384 13
Net earnings	$76,899 79

In addition to the expenses $4,537.21 was expended for extensions of tracks and sidings, leaving $72,362.58, or about two-thirds of the amount needed to pay interest on the bonds. It is believed that the rapid increase of business will soon make the road self-supporting. All deficiencies are now met by the Canton Company.

Boston & Providence.

This company works the following lines:

	Miles.
Main Line, Boston to Providence, double track	44.00
Dedham Branch	2.00
West Roxbury Branch	5.00
Stoughton Branch	4.04
India Point Branch, to freight wharves at India Point, opposite Providence	7.50
Total owned	62.54
Attleboro Branch, leased	4.00
Total worked	66.54

The company also owns a controlling interest in the Providence, Warren & Bristol road, 13.6 miles, and owns, jointly with the Old Colony, the Union Freight Railway, a track connecting those roads with the other lines entering Boston. The latest report is for the year ending Sept. 30, 1877.

The trial balance at the close of the year was as follows:

Capital stock ($63,952 per mile)		$4,000,000 00
Bonds (7 per cent.) due 1893 $7,995 per mile)		500,000 00
Notes payable ($12,697 per mile)		794,000 00
Balances due, unclaimed dividends, etc		44,990 03
Dividend No. 82, due Nov. 15, 1877		120,000 00
Profit and loss		393,763 29
Total ($93,584 per mile)		$5,852,753 32
Construction and equipment ($73,757 per mile)	$4,612,774 38	
Stoughton Branch	85 400 00	
Providence, Warren & Bristol stock	263,390 00	
Union Freight Ry. stock	79,014 42	
Real estate	214,295 51	
Improvement account	83,994 78	
Notes and balances receivable	302,081 99	
Cash and materials on hand	209,802 24	
		5,852,753 32

The notes payable are long interest bearing notes and fall due, $227,000 in 1877; $47,000 in 1878; $100,000 in 1879; $200,000 in 1880; $120,000 in 1881, and $100,000 in 1882. Authority has been given by the stockholders to renew as much of these amounts as may be necessary. They are for the most part held by savings banks and other moneyed institutions.

The work done for the year was as follows:

	1876–77.	1875–76.	Inc. or Dec.	P. c.
Train miles run	803,067	804.871	Dec.. 1,804	0.2
Passengers carried	3,197,600	3,475,378	Dec.. 277,778	8.0
Passenger mileage	35,995,043	37,948,007	Dec.. 1,952,964	5.1
Tons freight carried	631,850	589,643	Inc . 42,217	7.2

The earnings for the year were as follows:

	1876–77.	1875–76.	Inc. or Dec.	P. c.
Passengers	$800,356 25	$830,468 40	Dec.. $30,112 15	3 6
Freight	509,206 73	568,648 87	Dec.. 59,442 14	10.5
Express and mails	43,001 04	40,746 99	Inc.. 2,254 05	5 5
Rents	20,797 58	27,895 30	Dec.. 7.097 72	25.4
Total	$1,373,361 60	$1,467,759 56	Dec.. $94,397 96	6.4
Expenses	1,024,376 82	1,049,450 13	Dec.. 25,073 31	2.4
Net earnings	$348,984 78	$418,309 43	Dec.. $69,324 65	16.6
Gross earnings per mile	20,639 64	22,058 30	Dec.. 1,418 66	6.4
Net earn. per mile	5,244 74	6,286 59	Dec.. 1,041 85	16 6
Per cent. of exps..	74.59	71.50	Inc.. 3.09	4.3

The expenses include insurance, taxes and rental of Attleboro Branch, that rental amounting last year to $11,308.41. The income account was as follows:

Net earnings		$348,984 78
Interest account		101,031 01
Surplus for the year		$247,953 77
Balance from previous year		457,463 59
Total		$705,417 36
Dividends, 6 per cent	$240,000 00	
Worthless accounts charged off	3,364 80	
Estimated depreciation in Prov., W. & B. stock	28,289 27	
New iron bridge at Central Falls	40,000 00	
		311,654 07
Balance at close of year		$393,763 29

The new iron bridge over the Blackstone River at Central Falls has been completed at a cost of about $65,000, of which $40,000 has been charged to profit and loss, the rest to expenses. The building of this bridge was necessary, not only as a renewal, but to prevent serious obstruction and inconvenience in case of the destruction of the old wooden bridge by fire.

The report says: "Ten miles of single track or five miles of double track remain to be renewed with steel rails on the main road-bed.

"The line of larger boats from Providence to New York, which started in July last, proved to be very attractive and popular, and took its fair share of travel. It was closed for the season a month earlier than was intended, owing to the disaster which befell the Massachusetts. This powerful steamboat is being most thoroughly repaired, and, without doubt, will be even more staunch than when first launched. The Boston & Providence Railroad Corporation has no ownership of any description or nature in any steamboat, nor in the stock or bonds of any steamboat company, but it naturally takes a great interest in all such connecting lines.

"It is proper to state that the greater efficiency of this, the original steamboat route between Boston and New York, was construed as a hostile attack by one of the competing lines. Consequently an agreement for the sustaining of freights at remunerative rates was broken up in April last, thirty days' notice to that effect having been previously served upon us, and much of the business between Boston and New York is at present done at little profit, if not at a positive loss.

"A direct competing line to Providence, four miles longer than your road, was opened in September last over the Massachusetts & Rhode Island and Rhode Island & Massachusetts roads, leased to the New England Corporation, to which your attention was called last year. The effects of this competition are not yet fully developed, and cannot be definitely estimated."

The Minor Massachusetts Railroads in 1876.

Name of Road.	Property. Miles of road.	Locomotives	Passenger train cars.	Freight and other cars.	Liabilities. Stock	Funded debt	Other debt	Traffic. Train mileage	Passenger mileage	Tonnage mileage	Receipt per passenger per mile	Receipt per ton per mile.	Earnings. Gross earnings	Expenses	Net earnings	Earnings per mile	Per cent. of expenses
					$	$	$				Cts.	Cts.	$	$	$	$	
Ashburnham	3 0	1	1	..	99,370	12,000	2,790	11,268	36,042	9,187	5.00	18.00	5,125	4,309	816	1.7. 8	84.1
Boston, Barre & Gardner*	52.5	7	11	91	868,002	368,000	182,028	160,288	2,271,078	2,377,572	3.12	5.63	158,476	120,502	37,974	3,019	76.0
Boston, Revere Beach & Lynn	8.8	6	23	26	348,900	4,000	90,597	94,079	8,794,962		1.27	.....	119,990	73,204	46,786	13,660	61.0
Duxbury & Cohasset†	20.8	..	..	..	390,000	.....	88,732	41 936	846,080	85,770	3.:0	9.50	36,149	43,605	17,456	1,863	120 6
Fall River	12.3	1	..	..	200,000	200,000	34,730	29,551	387,757	185,240	4.70	2.20	25,086	14,506	10,580	2,044	57.9
Fall River, Warren & Providence†	5 8	..	..	..	150,000	300,000	19,439	17,444	544,887	68,325	3.93	3.40	27,473	19,828	7,650	4,737	72.2
Grafton Centre	3.0	1	1	2	29,830	10,000	3,060	14,185	86,334	.....	5.50	.....	4,622	4,049	573	1,541	87.6
Hanover Branch	8.0	2	6	18	123,950	40,000	186	23,120	310,276	57,120	2.20	5.40	9,968	23,016	6,952	3,746	76.7
Martha's Vineyard§	8.8	1	4	..	40,000	36,000	30,649	8,417	.....	.....	5.25	.....	8,286	7,053	1,206	999	85.4
South Shore	11.6	3	14	17	259,685	275,000	.....	57,942	3,035,035	226,600	2.30	10.20	90,816	63,335	27,481	7,829	69.8
Springfield, Athol & Northeastern	48.5	4	8	20	816,440	423,900	377,212	121,203	1,027,279	1,198,140	3.10	5.00	100,623	65,184	35,469	2,075	64.8
Springfield & New London‖	7.5	..	..	..	196,960	.....	.....	.....	.....	.....	.....	..	3,217	.....	.....	.....	.....
Troy & Greenfield¶	44.0	..	..	..	.....	.....	.....	.....	.....	.....	.....	.....	69,548	45,556	23,992	.....	...
Worcester & Shrewsbury	2.7	3	4	5	36,825	.....	11,437	30,000	226,311	.....	3.50	.....	7,921	7,026	896	2,934	88.7

* Includes Monadnock R. R., 16 miles, leased.
† Equipment leased.
‡ Deficit.
§ Passengers carried, 31,144; mileage not reported.
‖ Operated part of year by Connecticut Central, part by Connecticut Valley.
¶ Owned by State and used by Fitchburg R. R., on payment of tolls.

These figures are from the reports made to the Massachusetts Railroad Commission for the year ending Sept. 30, 1876; the table includes all the roads whose reports are not otherwise given, or included in those of lessees. Four roads, the Boston, Revere Beach & Lynn, the Grafton Centre, the Martha's Vineyard and the Worcester & Shrewsbury, are of 3 ft., the rest of standard gauge. All the narrow-gauge lines are short, and are used for passenger travel only.